SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY 1906.

GENERAL PHYSICS.

235. *Density of Ice.* **A. Leduc.** (Comptes Rendus, 142. pp. 149–151, Jan. 15, 1906.)—By operating with about 99 gm. of ice formed from distilled water, well boiled and otherwise treated, the author finds a density that is not less than 0·9172, and that increases as the dissolved gases are the more removed. Though unable to get rid of all traces of gas, he concludes that the density of perfectly gas-free ice at 0° is 0·9176, and that water which has been merely subjected to prolonged boiling (such as Bunsen used in his determination of the density of ice) still retains about 1 c.cm. of gas (reckoned under atmospheric pressure) per litre. R. E. B.

236. *Use of Logarithmic Scales.* **A. Ham.** (Assoc. Ing. Él. Liége, Bull. 5. pp. 354–371, June, July, Aug., 1905.)—The author draws attention to the advantages which in a number of cases result from the use of logarithmically ruled paper. As a first example, he considers the case in which the relation connecting two quantities y and x is suspected to be of the form $y = ax^m$. Since in this case $\log y = \log a + m \log x$, it follows that if the law holds, then on plotting $\log x$ as abscissa and $\log y$ as ordinate, the relation will be represented by a straight line, and the values of a and m are immediately obtainable. A similar method may be used with functions of the form $y = ac^{mx}$. The problem of dielectric resistance as determined by the loss of charge method, that of the potential drop due to a given current in a cable of given length and cross-section, and the problem of the self and mutual inductance of parallel wires, are worked out as further illustrations of the advantages of logarithmic scales. A. H.

237. *Sticking of Hot Charcoal Powder to Cold Bodies.* **G. Tammann.** (Ann. d. Physik, 18. 4. pp. 856–859, Dec. 12, 1905. Inst. f. anorgan. Chemie, Göttingen.)—On dipping a cold glass rod into hot powdered charcoal containing very little occluded gas, it is found, on withdrawing the rod, that a layer of the powder sticks to the rod, the thickness of the layer increasing with the difference of temperature between the powder and the glass. If the rod remains long enough in the powder to acquire its temperature the phenomenon does not take place, and, on the other hand, if the rod with the powder on it is held until the powder cools, it ceases to adhere. The other forms of carbon do not exhibit the phenomenon, which, however, is independent of the nature of the rod. With SiO_2 powder a slight amount sticks, but this does not fall off on cooling. The author shows by using a glass rod in one experiment and an earthed conductor in another, that the phenomenon is not of an electrical nature, no difference being observed in the two cases; also by performing the experiment in air at 0·5 mm. pressure and finding no change, he shows that the cause is not to be found in the currents due to occluded gases. He therefore concludes that the attraction is due to a particular kind of field of force only existing with considerable temperature gradient. S. G. S.

238. *Sympathetic Pendulums.* **D. J. Korteweg.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 418–431, Nov. 8, 1905. Proc. 8. pp. 436–455, Dec. 21, 1905.)—After reference to Huyghens' and Ellicott's original experiments and explanations, the general equations of motion for two pendulums suspended from a mechanism with one degree of freedom are deduced, and these are simplified by the introduction of the lengths l_1, l_2 of the equivalent simple pendulums, and of two constants c_1, c_2, the first of which depends only on the first pendulum and its manner of suspension, and the second on the second pendulum. The general case is first discussed, then that in which l_1 and l_2 differ rather much and c_1 and c_2 are small, then those in which l_1 and l_2 differ but slightly and c_1 and c_2 are (1) not small, (2) small: and the results are in entire accordance with the observations. R. E. B.

239. *Resistance of Tubes to Collapse.* **A. P. Carman.** (Phys. Rev. 21. pp. 381–387, Dec., 1905. Paper read before the Amer. Phys. Soc., April 28, 1905.)—Experiments have been made on the collapsing pressure of seamless brass tubes of small diam., the pressure being applied to the tube in the steel receiver of a Cailletet apparatus by means of a screw piston compressor. The results soon showed the narrow limits and inadequacy of Fairbairn's formula, $p = 806{,}300\, t^{2 \cdot 19}/ld$, where p is the external pressure in lbs. per sq. in., t the thickness of the walls in inches, and l and d the length and diam., in feet and inches respectively, and further investigation has proved that there is a minimum and definite length for each tube, beyond which the collapsing pressure is constant, and that for lengths less than this critical length, the collapsing pressures rise rapidly. A formula of the type proposed by Bryan and Love is shown to be more nearly true, and this is probably followed by the flues in most modern boilers. [l is wrongly given as the diam. in feet.] W. H. Si.

240. *Elongation under Bending.* **Bouasse** and **Berthier.** (Journ. de Physique, 4. pp. 821–829, Dec., 1905.)—A wire which breaks in tension practically without elongation, can by bending be elongated 20 or more per cent. The authors alternately bent a hard-drawn iron wire by winding on and unwinding from a cylinder, whilst under tension. A wire of 1·18 mm. diam. wound and unwound eight times on a cylinder of 2 cm. diam., under 20 kg. tension, had elongated 24 per cent. of its initial length. With a given radius of cylinder and given tension, the elongation per operation is at first a diminishing, and afterwards an increasing fraction of the length at the beginning of each operation. Experiments were made with regard to the position of the neutral surface. It was found that there is not quite perfect symmetry between winding and unwinding. The effect of winding and unwinding upon the modulus of rigidity depended upon the conditions of experiment. Microscopic examination of the surface did not reveal the nature of the changes in the material. F. R.

241. *Theory of the Solitary Wave in a Horizontal Elastic Tube.* **A. Boulanger.** (Comptes Rendus, 141. pp. 1001–1004, Dec. 11, 1905.)—Weber's experimental determination of the speed of propagation of a sudden disturbance in an incompressible liquid in a horizontal caoutchouc tube seems to conform to Boussinesq's theory of waves in a canal; but in the theory the length of the wave l comes in, and this was not measured in the experiment. To the second approximation (when weight is neglected) the theory gives $(1+l^2/4R_0^2)\sqrt{(k/\rho)}$ for the speed of propagation ω and $R^2-R_0^2=\frac{1}{4}l^2\operatorname{sech}^2\{(l/R_0)(x-\omega t)\}$ for the profile of the wave, R being the instantaneous radius of the tube at the section x at time t, R_0 the radius where there is no disturbance, ρ the density of the liquid, and k a constant depending on the elasticity of the walls. [Errata in the original paper are corrected on p. 1272, Dec. 26.] R. E. B.

242. *Physical Properties of Sodium Vapour.* **P. V. Bevan.** (Cambridge Phil. Soc., Proc. 13. pp. 129–131, Oct. 25, 1905.)—Wood has described a cloud of sodium vapour obtained by heating sodium in hydrogen, which possesses a cohesion almost as great as that of a liquid [see Abstract No. 2878 (1904)]. The author finds that this cloud is not formed if the sodium is heated *in vacuo* and that it is necessary to have an atmosphere of hydrogen incompletely dried. The sodium distils perfectly easily when heated *in vacuo,* no cloud being formed; an appreciable quantity distils over even at a temperature of 100°. E. C. C. B.

243. *Cohesion of Flowing Liquids.* **C. Steinbrinck.** (Phys. Zeitschr. 6. pp. 911–913, Dec. 15, 1905.)—The liquids, mercury and water, are contained in a syphon about 4 m. long; the object of the water is to enable the mercury to make good fluid contact with the glass. With columns 4 m. high, and the liquid flowing gently from one tube to the other through the bend at the top, the columns remain unbroken, showing that both the mercury and the water can be subjected to a tension of at least 5 atmos. without breaking, provided the velocity is small (1 or 2 cm. per sec.). With increasing velocity the cohesion diminishes. In the case of water the cohesion diminishes with increasing diam. of tube. In these experiments special precautions are taken to remove air from the tubes. S. G. S.

244. *Are Solid Bodies endowed with Effective Surface Tension?* **Van der Mensbrugghe.** (Annal. Soc. Sci. de Bruxelles, 29. pp. 206–209, 1904–1905.)—The consideration of the concave meniscus of a liquid in equilibrium along a solid vertical plate is attended with certain difficulties if an effective surface tension is ascribed to solids, and these difficulties the author regards as due to a misunderstanding of the true nature of liquids, which, although only very slightly compressible, are perfectly elastic. The introduction of a vertical sheet of glass into a vessel containing water immediately causes, in the layers near the sheet, a state of compression more marked than in the interior of the liquid mass. The water thus compressed cannot move towards the bottom without its elasticity becoming greater still, so that it rises along the sheet of glass and forms there an adherent layer to which the free layer of the meniscus becomes attached. This strong adhesion offers a sufficient reaction to the vertical component of the surface tension of the free layer, a component which becomes capable of sustaining the whole mass of liquid raised above the level in the vessel. T. H. P.

245. *Propagation of Nerve Impulse.* **W. Sutherland.** (Amer. Journ. Physiology, 14. pp. 112–119, Aug. 1, 1905.)—The electrical properties of nerve have received much attention, and the present hypotheses of nerve impulse propagation, though seemingly purely mechanical, are in reality to be regarded as electrical also. For though the author refers the "conductivity" of nerve to the rigidity of its substance, he has previously given electrical explanations of cohesion and rigidity. Two lines of thought lead to a conception of the possible importance of rigidity in the phenomena of nerve and muscle. In the first place it is known that a jelly offers but little more resistance to the passage of a small ion than does pure water at the same temperature, despite the enormous difference in the large-scale viscosities of the two media. This proves that in a jelly the molecules of the gelatine form a mesh dividing the jelly into compartments with network walls which confine the molecules of water in batches. The cellular structure gives to the jelly its rigidity, yet the meshes are so open that an ion urged forward by electric force has little difficulty in passing from one compartment to another, and encounters most of its resistance in passing through the batches of water molecules. Thus the jelly has rigidity on the molar scale, and fluidity on the molecular. Just as an ion moves through the jelly almost independently of the presence of the network, there ought to be phenomena of the jelly confined to the network as regards cause and effect. How would it be possible to propagate disturbance through a jelly without appreciably affecting its contained water, as a diver signals by his rope to the man in charge of the air pump? It seemed to the author that muscular contraction and nerve conductivity might be physiological answers to this query. The second line of thought regards the slowness of the propagation of nerve impulse as probably connected with the small rigidity of the soft tissues in the animal body. The paper then passes on to the quantitative and more purely physiological aspects of the subject. It is considered there is a splendid field for the pure physics of nerve. E. H. B.

246. *Motion of a Homogeneous Fluid Ellipsoid whose Parts attract according to Newton's Law.* **W. Stekloff.** (Comptes Rendus, 141. pp. 999–1001, Dec. 11; pp. 1215–1217, Dec. 26, 1905, and 142. pp. 77–79, Jan. 8, 1906.)—The motion of a homogeneous fluid is considered whose free surface is under constant external pressure and keeps the shape of a spheroid with its centre fixed in space. The possible cases of motion are investigated wherein the velocity of any point relatively to the moving principal axes of the spheroid is a homogeneous linear function of the position of the point relative to these axes. If the spheroid is oblate, there is but a single case, viz., that of Dirichlet; if it is prolate, there are three solutions, viz., Dirichlet's and two others, in which the body rotates like a solid about its centre, but not uniformly, so that, the instantaneous axis of rotation not being situated in general in one of the principal planes, the relative motion is not stationary. Riemann's proposition as to the motion of an ellipsoidal mass of invariable external form is found to be exact only if no two of the axes are equal, and it thus does not apply to a spheroid. These two particular cases for a prolate spheroid are treated in separate notes, wherein ω is written for the projection

of the angular velocity of the spheroid as a solid body on its equatorial plane. In the first case ω remains constant throughout the motion, and may be any magnitude less than $2\sqrt{(\pi/15)}$, and the reciprocal of the eccentricity of the spheroid is the single real positive root of the equation—

$$\tfrac{1}{2}(\sigma-1)(\sigma^2-1)\left[(3\sigma^2-1)\log\left\{(s+1)/(s-1)\right\}-6\sigma\right]=\omega^2/\pi.$$

In the second case ω must be less than Ω, where Ω^2/π is the value of—

$$\psi(\sigma)\equiv\tfrac{1}{2}(\sigma+1)(\sigma^2-1)\left[(3\sigma^2-1)\log\left\{(\sigma+1)/(\sigma-1)\right\}-6\sigma\right]$$

when for σ is put the single positive root of the equation—

$$(15\sigma^3-3\sigma^2-9\sigma+1)\log\left\{(\sigma+1)/(\sigma-1)\right\}=2(15\sigma^2-3\sigma-4),$$

which lies between 1 and 5/3 ; and the reciprocal of the eccentricity is given by the real positive roots of the equation $\psi(\sigma)=\omega^2/\pi$, of which there are one or two, according as ω is less or greater than $2\sqrt{(\pi/15)}$. R. E. B.

247. *Atom with Enormous Energy for Radio-activity.* **Kelvin.** (Phil. Mag. 10. pp. 695–698, Dec., 1905.)—This article puts forward a plan of an atom capable of storing an electrion (or negative electron) with enormous energy for radio-activity. The atom of ponderable matter is supposed to be intrinsically charged in concentric spherical shells, each such layer being uniform in itself but the density and sign of the distribution varying from layer to layer. A curve, called the work curve, is then plotted, whose ordinates show the work required to bring an electrion from infinity to the point in question. In the curve drawn there are two minima, one just within the radius of the atom and a second at its centre. Between these two minima there is one maximum. The curve is of course symmetrical about the centre of the atom. If therefore an electrion be placed at or near the centre of the atom, *i.e.*, between the two maxima of the work curve, it has stability, but only through a narrow range. If it is taken farther away from the centre than these maxima, the electric force of the atom upon it will shoot it out of the atom with prodigious velocity, which will be but slightly diminished by the attraction of the whole atom when it gets outside. E. H. B.

248. *Mean Annual Temperature of the Surface of the Pacific near Japan.* **Y. Wada.** (Monthly Weather Rev. 33. pp. 304–305, July, 1905. From Bull. No. 1 of the Central Meteorological Observatory, 1904.)—During the twenty years 1882–1901, 133,255 observations were taken on 1,086 vessels (848 Japanese) in the area situated between Long. 114° and 146° E. and Lat. 22° and 46° N., this area being divided into squares of 2° × 2°. Observations were, in the latter years, taken at 2, 6, 10, both a.m. and p.m. The highest mean annual temperature of 30° C. occurs in Formosa Strait, the lowest, of — 3° C., in the Gulf of Pechili and near Vladivostock. The annual range of variation increases with higher latitudes, and as we approach the land from the sea, being greatest, 27° C., in the Gulf of Pechili. With some exceptions the march of temperature follows closely the ocean currents, the polar current and the bifurcating equatorial or Kuroshiwo current. H. B.

249. *Variation in Minimum Temperatures on still, clear Nights within a Village.* **W. I. Milham.** (Monthly Weather Rev. 33. pp. 305–308, July, 1905.)—The village of Williamstown, Mass., the seat of Williams' College, lies in a depression about 8 miles in diam., surrounded by mountains up to 3,500 ft. The level-differences within the village, which consists of wide streets and detached houses in ample gardens, amount to 120 ft. Remarkable discrepancies between the minimum thermometers at various spots having been reported, ten self-registering alcohol minimum thermometers, previously tested, were mounted under identical conditions, 5½ ft. above the ground, which was everywhere covered with snow, and without shelter. The particular observations reproduced were taken during 36 nights of the winter 1904–05, together with other meteorological observations. The ten thermometers differed in some cases by 10° (apparently Cent.), on an average by about 5°, and this was practically the same on fairly warm and very cold nights. One station proved almost always the coldest, two stations were generally warmer than the others. But there is little regularity; elevation plays an important, but not a decisive part. H. B.

250. *Meteorological Work of U.S. Naval Eclipse Expedition, Aug. 30, 1905.* **F. H. Bigelow.** (Monthly Weather Rev. 33. pp. 295–296, July, 1905.)—A preliminary account of the work of the party of 20 observers, under the author and S. Hanzlik. Kite ascensions and sea-current measurements were made on the *Cæsar* on the way out; temperature reversals over the sea (Hergesell) were not observed. The party divided at Gibraltar, some proceeding to Bona and Guelma, in Algeria, the others to six stations at Porta Coeli, Castellon, Tortosa, Daroca, Zaragoza, and Guadalajara, in Spain; the last three stations are not influenced by the strong sea-breeze. At Daroca, where the sky was perfect on August 30, the barometer remained unaffected during the eclipse; the temperature sank by 8° F. in the shade and by 18° in the sunshine; the shadow bands were feeble, but were observed for considerable periods; the corona was typical of a maximum spot period, and stellar points were noticed in the streamers, which extended two diameters from the sun. H. B.

251. *Diurnal Periods in the Lower Strata of the Atmosphere.* Parts V. and VI. **F. H. Bigelow.** (Monthly Weather Rev. 33. pp. 292–295, July, and pp. 356–360, Aug., 1905.)—V.—Variable Action of the Sun and Its Effects upon Weather Conditions. VI.—General Review of the Status of Cosmical Meteorology.—The first paper [see Abstracts Nos. 1599 (1904) and 2144 (1905)] is a summary of our knowledge concerning the sun and the periodicity of solar phenomena, the solar day, whose length ranges from 26·68 terrestrial days in the equatorial regions to 29·5 days in the polar regions, sun-spots, faculæ, flocculi, prominences, and the corona. The mean annual pressures and temperatures for different parts of the earth give curves which are directly or inversely similar to the prominence frequency curves with their periods of 11 and 3 years. The second article points out that meteorology is passing through a transition period. Our views regarding the magnetism and radiation of the sun and the general circulations of the atmosphere and cyclones have changed; really homogeneous series of observations extending over long periods are nowhere available, because the methods and hours of observations, the instruments, and the stations or their surroundings have been altered. Much of the accumulated material is valueless; all rough-and-ready methods of computing must be abandoned. The margin of variability induced by the unsteady energy of the sun is quite narrow. Yet the seasonal and annual changes in the climate which each country experiences depend

upon the variable output of the solar energy, as recorded in the circulation of the sun's atmosphere and in our own atmosphere. Having referred to his system of reducing meteorological data and to the terrestrial magnetic field as being the best unifier or integrator in building up a meteorological ephemeris, the author discusses the sun as a magnetised sphere, and solar radiation, and concludes with remarks on the general organisation of the research observatory. H. B.

252. *Trombes of July 4 and Aug. 28, 1905.* **Maillard.** (Comptes Rendus, 141. pp. 742–743, Nov. 6, 1905.)—In the trombe of July 4 the vortex approached Cravant, near Beaugency, at 9 p.m., after a very hot day, with a velocity of 12 m. per sec., and the damage was confined to the ring space between two circles of diam. 250 and 400 m. about the advancing centre, and to the north-western and south-eastern portions. The barometer went down, but exact measurements are not available. Windows were burst from the inside outwards. **T. Moureaux.** (Ibid. 141. pp. 510–511, Sept. 11, 1905.)—The trombe of Aug. 28 moved from Saint-Maur to Champigny between 3.10 and 3.25 p.m., 5 km. in 25 minutes, from WSW. to ENE. The vortex movement was counter-clockwise and did considerable mechanical damage. At Parc Saint-Maur, 1 km. from the path, the low barometer rose suddenly at 3.10 p.m. by 0·5 mm., and then receded slowly; there was no change in the wind direction, nor in the temperature. 27 mm. of rain fell before and after the event. H. B.

253. *First Observations with Registration Balloons in America.* **A. L. Rotch.** (Amer. Acad., Proc. 41. No. 14. pp. 347–350, Dec., 1905.)—Ballons sondes of the Assmann type, fitted with instruments by Teisserenc de Bort, were sent up at St. Louis during and after the Exhibition of 1904 by the author, Clayton, and Fergusson. The inflated balloons had a diam. of about 6 ft., and they all burst and descended within less than 3 hours; the instruments, comprising the smoked aluminium cylinder and clockwork, weighed 1½ lbs.; the balloons and instruments were recovered in 22 out of 28 cases. Heights of 10 miles were several times exceeded; the minimum temperature of −111° F. was recorded on Jan. 25, 1905, at an altitude of about 9 miles, the barometer on the ground being high at the time. H. B.

254. *Pulse of the Atmospheric Circulation.* **W. N. Shaw.** (Nature, 73. pp. 175–177, Dec. 21, 1905.)—Announcing that twelve years' anemometer records from St. Helena are now being analysed, the author points to a peculiar similarity between rainfall and trade wind velocity curves. The year 1903 was very wet in Southern England, and the average trade wind velocity at St. Helena was 21 miles per hour for the year, against 18 miles for the other years; 1893 was very dry in the spring, and the trade wind velocity of the spring months varied between 14 and 16 miles. The average annual rainfall curves for Southern England and the trade wind velocity curves for St. Helena show, indeed, a striking similarity; and the year 1898, which had two wind-velocity maxima, in March and Oct. (instead of the usual one maximum in Sept.), also shows two rainfall maxima at Southampton, in May and Nov. In other individual years the similarity is by no means distinct, however. The author further remarks that the rainy movements in our districts are south to north and west to east, and that the enormous energy quantities involved in very heavy rainfalls should not be overlooked by meteorologists. H. B.

255. *Earth-temperature in Japan.* **S. T. Tamura.** (Monthly Weather Rev. 33. pp. 296–302, July, 1905.)—The theory of temperature-distribution in a solid whose surface is heated and cooled periodically is first recounted, and its application by Nakamura to observations of earth-temperatures at Tokyo, by Oishi to observations also at Tokyo, and by Okada to observations at both Nagoya and Osaka, is described. The average value of $a^2 \equiv k/\rho C$ at Tokyo, where the soil is loam, appears to be about 0·00251, and the amplitude of the principal variation to be about $13{\cdot}1\, e^{-x/170}$, where x is the depth in metres. At Osaka, where the soil is composed of granite sand, a^2 is much larger, being apparently about 0·00858 at the surface, but diminishing as the depth increases. At Nagoya, on the contrary, a^2 increases with the depth, the soil there being less uniform. For the soil at Osaka the specific heat was found to be about 0·204, and the mean conductivity about 0·00265 in c.g.s. units. R. E. B.

256. *Calculation of the Seiche Periods and Nodes of Lochs Earn and Treig.* **Chrystal** and **E. Maclagan-Wedderburn.** (Roy. Soc. Edinburgh, Trans. 41. 32. pp. 823–850, Nov. 7, 1905.)—Chrystal having given a mathematical theory of seiches and deduced formulæ [see Abstract No. 1698 (1905)], the authors calculate the periods and nodes for the three seiches of Lochs Earn and Treig from the bathymetric data of the Scottish Lake Survey. Both the lakes have a simple configuration. Wedderburn observed the periods of Treig in Oct. and Nov., 1904, with the aid of one limnograph, which was destroyed during a storm; the position of the nodes is not known. On Loch Earn, Chrystal and J. Murray made observations in June and July, 1905, first with two Sarasin limnographs, then with a more sensitive Endrös limnograph. The observed and calculated periods are in close agreement, and the authors point out that the calculation of the periods should prove more reliable than that of the nodes, because the nodal lines would be displaced by sudden alterations in the depth and width of the lake which might affect the periods very little. The paper is illustrated by two maps. H. B.

257. *New Method of Determining the Refraction Constant.* **G. A. Hill.** (Nature, 73. p. 110, Nov. 30, 1905. From Popular Astronomy, Vol. 13. No. 8.)—The author describes a new method of determining the constant of refraction. Two stars are chosen, separated by about 12 hours in Right Ascension and of about the same declination, and observations are made of the times at which they transit across a horizontal wire *in the prime vertical.* In each case the refraction diminishes the hour angle, and the arithmetical sum of the hour angles of the two stars will differ from the difference of their right ascensions by double the refraction, expressed in time, at the zenith distance at which they were observed. For the carrying out of this inquiry the author recommends the employment of an instrument of the type of the modern zenith telescope. The apparatus will be adjusted in the prime vertical, provision being made in the mounting for rotating the whole about a vertical axis, stops being so fixed that the line of collimation remains unchanged. The most favourable localities for such determinations would be stations at or near the earth's equator. C. P. B.

258. *Total and Intrinsic Luminous Intensity of Solar Corona.* **C. Fabry.** Comptes Rendus, 141. pp. 870–873, Nov. 27, and pp. 940–942, Dec. 4, 1905.)—The author was stationed at Burgos. As the standard candle comparison was inconvenient for open-air observation, use was made of an intermediate light by employing an osmium-filament lamp, taking about 1 amp. at 4 volts. The difference of tint of the two illuminations introduced some uncertainty, but this was partially overcome by the use of a liquid screen containing an ammoniacal solution of sulphate of copper. It was concluded that the total luminosity of the corona was equal to three-quarters of that of the full moon, but the presence of clouds at the time of eclipse may have had some influence on the measures. In the second paper an account is given of the determination of the intrinsic intensity of various portions of the coronal radiation. Using for comparison an osmium lamp, the coronal image given by a lens of 1·20 m. focus was thrown on a plate carrying a diaphragm, so that any part of the corona could be examined. The aperture of the objective could also be rapidly altered. It was found that the intrinsic brightness of the corona at a point 5′ from the limit of the sun, in the direction of the equator, was about 720 candles to the square metre. That of the full moon was found to be 2,600 of the same units, so that the intrinsic intensity of the coronal light at the point indicated was about 0·28 that of the lunar surface. This is in good accord with the previous determination by Turner in 1898, who, using a photographic method, obtained the value 0·25. Comparing these values with the measured brightness of the sky close to the sun during ordinary times, it is found that the corona is probably about 2,000 times less intense than the background of illuminated sky against which it is projected, and this indicates the difficulty to be contended with in any attempts to photograph or see the corona during ordinary sunlight. It is probable that certain exceptional stations at high altitudes, and with very dry climate, may offer the least discouraging conditions. C. P. B.

259. *Spectroscopic Observations during the Solar Eclipse, August* 30, 1905. **P. Salet.** (Comptes Rendus, 141. pp. 994–995, Dec. 11, 1905.)—One of the spectroscopes employed was arranged for the visual spectrum, the other for the ultra-violet, the slits bisecting images of the sun furnished by two heliostats. The slit of the visual spectroscope crossed an important group of prominences, and the spectrum corresponding to this side of the sun shows 14 lines, whose wave-lengths, &c., are given in the paper. Of these only one, the coronium line at 530·3, seems to be of coronal origin. A line at 402·5 does not correspond to any known element, but has been previously observed in the lower chromosphere with the objective prism. The spectrum of the other side of the corona only shows the coronium line, and H and K of calcium. The photographs of the ultra-violet spectrum, which extends to λ308, are rich in bright lines, of which 22 are easily identified. Wave-lengths of 8 strong lines due to titanium are given. Most of the others belong to iron or hydrogen, and probably emanate from the outer chromosphere. One line, however, corresponds to the coronal line 345·6. Two new lines, at 331·5 and 327·1, the latter being very bright, do not correspond to any known line, but whether they belong to the chromosphere or corona it is impossible to say. Photographs of the corona were taken with two short-focus objectives of about 10 cm. aperture, exposures not exceeding 3 sec. They show numerous streamers extending in certain cases to more than two solar diameters from the limb; some clearly curving back on themselves. On the plates with shortest exposure there is an interesting correspondence between two of these streamers and the two finest prominences. On all the plates the moon appears decidedly darker than the sky. The polarisation results were given in a previous note [see Abstract No. 31 (1906)]. A. E.

REFERENCES.

260. *Diminution of Pressure attending Increase of Speed in Fluids.* **W. S. Franklin.** (Science, 22. pp. 793–794, Dec. 15, 1905.)—This phenomenon is neatly illustrated by letting a jet of water impinge vertically on a light metal disc placed horizontally in a trough and prevented by a pin from moving sideways: the disc rises and floats in the water that fills the trough. R. E. B.

261. *Hydrodynamical Lecture Apparatus.* **L. Kann.** (Phys. Zeitschr. 7. pp. 36–37, Jan. 15, 1906.)—Illustration of a simple apparatus for demonstrating the flow of water through pipes; any inclination to the horizontal can be given to the pipe and the pressure at various places along its length observed by small glass standpipes connected to the main pipe. L. H. W.

262. *Seismoscope.* **G. Agamennone.** (Accad. Lincei, Atti, 14. pp. 681–688, Dec. 17, 1905.)—Description of a seismoscope with double horizontal pendulum, for detecting remote seismic disturbances. The magnifying power for slight disturbances is extreme: the earthquake at Lake Baikal on July 23 set the lever swinging through 60 cm., while the great De Rossi 3½-metre tromometer on the same column (at the Rocca di Papa Royal Geodynamical Observatory) oscillated only ½ mm.; and the lever is never at perfect rest. A. D.

263. *Sankey's Vibratory Testing Machine.* (Mech. Eng. 16. p. 690, Nov. 11, 1905.) —The specimen is gripped horizontally in a vice, and a lever, free to move in a horizontal plane, is attached to its other end. A handle is pivoted to this lever, and the relative movement of the two is resisted by springs, multiplied, and recorded on a rotating disc. F. R.

264. *Mass of Cubic Decimetre of Pure Water.* **H. Buisson.** (Soc. Franç. Phys., Bull. 3. pp. 447–456, 1905. Journ. de Physique, 4. pp. 669–677, Oct., 1905.)—Optical methods employed. The cubic decimetre of pure water at 0° weighs 999·971 gm. A. D.

265. *Dimensions.* **P. Juppont.** (Écl. Électr. 46. pp. 41–50, Jan. 13, 1906.)—Suggests a new order of dimensions in L and T only, based upon Kepler's laws, which leads to a static and a dynamic system differing by a velocity in the terms respectively measuring mass or quantity. Electrical and magnetic analogies. Newton's law implies complete conservation of energy in whatever form it is imparted to the gravitational medium; this medium cannot be the same as the ether. A. D.

266. *Partial Differential Equations in Physics.* **W. Wien.** (Phys. Zeitschr. 7. pp. 16–21; Discussion, pp. 21–23, Jan. 1, 1906. Paper read before the 77 Naturforscherversamml. at Meran.)—Discusses the part played by partial-differential equations in physics. E. H. B.

267. *Problem of Secular Perturbations.* **A. Wilkens.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 51. pp. 1062–1076, Dec. 14, 1905.)—A mathematical treatment of the problem of three bodies, with solutions of the differential equations in the case of the planetoids.

268. *Strength and Elasticity of Reinforced Concrete.* **W. H. Warren.** (Roy. Soc. N.S. Wales, Journ. and Proc. 38. pp. 140–190, 1904.)—A very full paper giving experimental results.

269. *Economic Depth and Depth of Greatest Stiffness of a Bridge Truss.* **W. Merriman.** (Amer. Phil. Soc., Proc. 44. pp. 164–165, May–July, 1905.)—For the type of truss known as the deck Pratt truss the author shows that the depth of greatest stiffness is slightly smaller than the economic depth. No added stiffness is therefore obtained by exceeding the economic depth. L. H. W.

270. *Stresses in Masonry Dams.* **M. am Ende.** (Engineering, 80. pp. 751–753, Dec. 8, 1905.)—The stresses occurring in straight masonry dams are calculated, the conditions necessary for a section to be treated as a cantilever being discussed and found to hold good. The particular case of a masonry dam 23·5 m. high is given, and the curves of maximum pressure and shear are determined and given in the form of a diagram. S. G. S.

271. *Nickel-steel Winding-rope Wire.* **J. Devis.** (Iron and Steel Mag. 10. pp. 364–366, Oct., 1905. From the Iron and Coal Trades Review, Aug. 4, 1905. Abstract.)—The author experimented with ropes of steel containing 1·89, 5·74, 6·28 per cent. Ni, and with comparison carbon steel ropes of wires of the same breaking strength. They were tested under repeated torsion, bending, and shock, and the effects of rusting in steam were investigated. On the whole, the experiments do not show any superiority of the nickel steel over the carbon steel, and the author thinks that nickel steel cannot come into consideration as a material for winding ropes. F. R.

272. *Superficial Tension.* **C. Forch.** (Ann. d. Physik, 17. 4. pp. 744–762, Aug. 22, 1905. Techn. Hochschule, Darmstadt, June, 1905.)—Detailed paper on surface tension of various inorganic saline solutions, methods of measurement, and discussion of the results of others. A. D.

273. *Gravity Determinations.* **C. Aimonetti.** (Accad. Sci. Torino, Atti, 40. No. 14. pp. 686–706, 1904–1905.)—Determination of the local variations of gravity in Lombardy, the extremes being 980·732 (Avigliana) and 980·562 (Susa) where the theoretical are respectively 980·610 and 980·609, according to the formula $\gamma_0 = 978{\cdot}0\,(1 + 0{\cdot}005310 \sin^2\phi)$, or 980·630 and 980·629 according to Helmert's formula $\gamma_0 = 978{\cdot}046\,[1 + 0{\cdot}005302 \sin^2\phi - 0{\cdot}000007 \sin^2 2\phi]$. A. D.

274. *Gravitation.* **V. Crémieu.** (Comptes Rendus, 141. pp. 653–656, Oct. 23, and pp. 713–715, Nov. 6, 1905. Soc. Franç. Phys., Bull. 3. pp. 485–499, 1905. Journ. de Physique, 5. pp. 25–39, Jan., 1906.)—Cavendish experiment, with torsion-balance, under liquid. The conditions are as good as, if not better than, those in air. A. D.

275. *Pressure and Rainfall in the Trades-Monsoon Area.* **W. L. Dallas.** (Amer. Phil. Soc., Proc. 44. pp. 159–163, May–July, 1905.)

276. *Frequency Curves of Meteorological Elements.* **J. P. Van der Stok.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 270–283, Oct. 12, 1905. Proc. 8. pp. 314–327, Oct. 25, 1905.)—After stating that it might be useful to investigate the variations of meteorological phenomena more closely by the theory of frequency curves, a discussion is started on the primary question as to how far monthly means may be in accordance with the common law of probability. The materials chosen for the inquiry are (1) monthly means of barometric pressure at Helder for the 60 years Aug., 1843, to July, 1902; (2) monthly means of barometric pressure at Batavia for the 37 years 1866–1902; (3) monthly means of atmospheric temperature for the whole of France during the 50 years 1851–1900. C. P. B.

277. *Thames Flow and British Pressure and Rainfall Changes.* **N. Lockyer** and **W. J. S. Lockyer.** (Roy. Soc., Proc. Ser. A. 76. pp. 494–506, Dec. 6, 1905.)—The communication was noticed in Abstract No. 1697 (1905). It is pointed out that for all practical purposes the pressure and rainfall data of one station, namely, the Radcliffe Observatory, Oxford, are sufficient to indicate very closely the subsequent changes in the Thames flow. H. B.

278. *Fluctuations of Lake Ontario.* **K. Tully.** (Canad. Inst., Trans. 8. pp. 1–10, Sept., 1905.)—Deals with observations from 1854 to the end of 1903.

279. *Sun-spots, Seismic Phenomena, and Climate.* **H. I. Jensen.** (Roy. Soc. N.S. Wales, Journ. and Proc. 38. pp. 40–90, 1904.)—A further paper [see Abstract No. 1886 (1904)] discussing the different theories concerning the relation between sun-spots, volcanic and seismic phenomena, and climate. Unsuitable for abstracting.

280. *Zodiacal Light.* **K. Schwend.** (Beibl. Ann. d. Physik, 29. 19. pp. 1018–1019, 1905. Extract of Munich Dissertation, 1904.)—Discussion of observations of the zodiacal light, with reference to its visibility, position, extent, form, and colour. C. P. B.

281. *Inclinations of Planetary Equators to the Ecliptic.* **E. Belot.** (Comptes Rendus, 141. pp. 937–939, Dec. 4, 1905.)—A discussion is given of the general hypothesis of a rotating mass of gas, and the deduced formulæ are applied to the cases of the various planetary members of the solar system. Taking the radius of the earth's orbit as unit, the distances of the other bodies are computed and referred to the best known actual volumes, with very close coincidences in most cases. One of the zones found coincides very nearly with the orbit of comet Encke. C. P. B.

282. *Spectrum of ε Pegasi.* **E. Haschek** and **K. Kostersitz.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1253–1267, July, 1905. From the II. phys. Inst. der k.k. Univ., Wien.)—Tables are given of the lines measured on a spectrum photograph of ε Pegasi obtained at the Lick Observatory. The spectra extend from λ4308·05 to λ4438·56, and comparisons are given of the nearest known terrestrial lines to suggest the origins of the lines, both in the solar spectrum and published by Rowland, and in the arc and spark by Exner and Haschek. C. P. B.

283. *Nova Aquilæ,* 1905. **J. A. Parkhurst.** (Astrophys. Journ. 22. pp. 266–270, Nov., 1905.)—The region of this Nova was included on 7 pairs of plates taken by Barnard with the Bruce photographic telescope in 1904, and since the announcement of the discovery 5 plates have been taken with the 24-in. reflector. From its absence on the 1904 series, it is concluded that the Nova was at least fainter than the 15th magnitude in the spring and summer of 1904. A reproduction of one of the plates is given, and a table showing the diminishing magnitude of the star during Sept., 1905. With the 40-in. Yerkes telescope the Nova appeared slightly nebulous. not focussing as sharply as neighbouring stars of about the same brightness. C. P. B.

LIGHT.

284. *A Standard of Illumination.* **J. Violle.** (Comptes Rendus, 141. p. 1188, Dec. 26, 1905.)—A light standard was tried, which would give a constant radiation at a fixed temperature, by boiling a metal, such as silver or copper, in an electric furnace and heating a carbon retort by means of the metallic vapour. The interior of the retort was to serve as the standard source of light. G. E. A.

285. *The Matthews and the Russell-Léonard Photometers.* **E. P. Hyde.** (Bureau of Standards, Bull. 1. 2. pp. 255–274, Feb., 1905.)—An examination is made of the theory of the Matthews and the Russell-Léonard photometers in connection with the design of instruments of this type for the Bureau of Standards. It is pointed out that the assumption by Matthews of a sphere given by the equation $I = I' \sin \theta$ as a candle-power surface in order to check the error made by taking a limited number (11 pairs) of mirrors is inadmissible. In this case a single mirror pair would give the true m.s.c.p. By considering various theoretical cases the author deduces a distribution of the mirrors which gives practically accurate results. He shows that the distribution of the 11 mirrors every 15° (0°, 15°, 30°, . . .) may give errors amounting to over 2 per cent. Twenty mirror-pairs properly distributed are theoretically sufficient to give mean spherical and mean hemispherical candle-power values in the Matthews photometer. Assuming that the vertical c.p. curve of an arc lamp is an ellipse with the major axis inclined at 45° to the horizon, and that the arc is at the upper extremity of the major axis, the best arrangement of 4 mirror pairs for the Russell-Léonard photometer is found. With 4 mirror pairs arranged at these angles the error for the curves $I = I' \sin \theta$ and $I = I' \cos \theta$ are 1·6 and 0·1 per cent. respectively. When the Russell-Léonard photometer is used for finding the m.s.c.p. of glow-lamps the distribution of the mirrors is calculated so that the readings are correct for the curves $I = I'$, $I = I' \sin \theta$ and $I = I' \cos \theta$. The instrument will then give correct readings in all practical cases. The author concludes that for glow-lamp work, 12 mirrors, each 6 in. broad, can be arranged in a circle of 8 ft. diam. and yield results accurate within 0·5 per cent., whereas the Matthews instrument as at present constructed gives an error of over 2 per cent. when applied to a lamp having the intensity curve $I = I' \cos \theta$. The Russell-Léonard photometer also has no "objectionable smoked disc."

A. R.

286. *Geometry of Double Refraction.* **G. Wulff.** (Ann. d. Physik, 18. 3. pp. 579–589, Nov. 21, 1905.)—The author seeks a simple geometrical expression for the difference of path of the two plane waves into which a single plane wave of light is broken on entering a crystal plate. Let O be the point where the normal to the incident wave meets the first surface of the crystal plate, and M a point on this surface whose distance from O is $OM = n \sin r$. The portion η, of the normal through M to the plate, intercepted between the ordinary and extraordinary waves will be $n' \cos r' - n'' \cos r''$, n' and n'' being the indices, r' and r'' the angles of refraction, for the ordinary and extraordinary rays. But if g be the difference of path, and t the thickness of the plate, we have by a well-known formula, $g = t\,(n' \cos r' - n'' \cos r'')$. Therefore the intercept $\eta = g/t$. If the point M move on the surface of the crystal so that the intercept η remains constant, M will trace a curve, called a curve of equal difference of path. If m be the number of wave-lengths in air, we have also $\eta = m\lambda/t$. The author describes two methods of observing the above curves. The angle of emergence into air corresponding to a given value of η can be directly measured by means of a goniometer; or a polarisation microscope may be used which, owing to the large aperture, enables the images of a whole series of curves of equal difference of path to be seen in the field at once, the images being similar to the curves themselves. Tables of results of measures made by the author are given in illustration. A. E.

287. *Determining Thickness and Optical Constants of Transparent Metal Films.* **W. Betz.** (Ann. d. Physik, 18. 3. pp. 590–605, Nov. 21, 1905. Extract from Dissert., Leipzig, 1905.)—The required quantities were calculated from the elliptic polarisation of the transmitted light and observations of intensity, the method enabling the thickness, index, and coefficient of absorption to be determined simultaneously. The author's formulæ were derived from the theoretical investigations of Voigt and Drude [Wied. Ann. 25. p. 25, 1885; and 43. p. 126, 1891]. His measures of elliptic polarisation were made with the spectrometer described by Drude [Optik, p. 238] and a banded compensator, as a compensator with homogeneous field gave too little light. A table of results for three silver and two copper mirrors is given, from which the following figures are extracted :—

		n.	*nk.*	Mean Thickness.			*n.*	*nk.*	Mean Thickness.
Silver I....	Red ...	0·24	4·15	27·1	Copper I.	Red ...	0·62	3·86	20·2
	Green	0·14	3·30			Green	0·78	2·64	
	Blue...	0·30	2·52			Blue...	0·94	2·50	
Silver II...	Red ...	0·28	4·40	47·8	Copper II.	Red ...	0·77	4·00	37·9
	Green	0·15	3·25			Green	1·12	2·70	
	Blue...	0·26	2·75			Blue ..	1·32	2·47	

With gold and platinum, consistent results could not be obtained. Under the microscope with strong homogeneous immersion, a grain-like structure was discovered in the gold films, the grains being apparently diffraction phenomena due to small holes. A. E.

288. *New Arrangement to obtain a Monochromatic Image of a Luminous Source.* **A. Nodon.** (Comptes Rendus, 141. pp. 1010–1013, Dec. 11, 1905.)—In spectroscopic apparatus for observing solar prominences, &c., a monochromatic image has been hitherto produced by motion of the spectroscope, the photographic plate, or the projection objective. An apparatus is described in which this is avoided by giving the motion to two mirrors oscillating about the same vertical axis. One of these reflects the rays from the siderostat into the spectroscope. A slit cuts off a portion of the light, which is reflected back to the second mirror, from which it passes into the observing telescope. The two mirrors, set at an angle, can be made to oscillate rapidly (more than 10 oscillations per sec.) by means of clockwork.

G. E. A.

289. *Photography, Reversibility, Bromides.* **S. E. Sheppard.** (Chem. Soc., Journ. 87. pp. 1311–1332, Aug., 1905.)—Equilibrium in development in ferrous oxalate developer is reached when $av/bc = \xi$, the equilibrium constant, about 680, where a, b, and c are gm.-mols. of ferrous and ferric iron and bromide respectively, and v is the volume of the solution. At N/1000 bromide the ferric would have to be 1,500 times the ferrous to bring development to a standstill. The velocity of development depends mainly on diffusion processes; $dD/dt = K(D_\infty - D_t)$ where D_∞ and D_t are the ultimate and the instantaneous densities and $K = \Delta a/S$, where Δ is the diffusivity of the developer, a its concentration, and S the diffusion path (probably the gelatine skin surrounding the grain of silver halide). Bromide however imports or emphasises the effect of chemical reaction: the effect of bromide on the exposure curve is to make $D = \gamma \log E/i - 114\, n/t$, where n is the normality of the bromide and t the time of development; and for the development curve, $D = D_\infty(1 - e^{-Kt}) - K' [Br/t$, where [Br is the concentration of the bromide. The presence of bromide causes an initial induction or retardation period, the length of which depends both on the exposure and on the concentration of the bromide: probably primarily due to the time required for the first precipitation of metallic silver from its supersaturated solution. Once this precipitation has begun, the chemical velocity of reaction increases so as greatly to exceed the diffusion of the reducer, so that in the later stages of development bromide has but little influence. The "time of first appearance" measures the velocity of development in the initial period; and up to N/25 bromide this time of first appearance is $T_0 = a \log [Br + b$, where a is a function of the exposure and of the plate, [Br is the concentration of the bromide, and b is a function of the exposure. In normal development T_0 is inversely proportional to the ultimate density, and for a considerable range it is inversely proportional to the log. of the exposure, as well as directly proportional to the log. of the bromide concentration. The latent image appears not to consist of metallic silver. With bromide the exposure curve is shifted along the exposure axis: $\Delta \log E = \text{const.}$ The initial stage of normal development, and the progress of retarded development, depend on the velocity of chemical reaction as well as on that of diffusion; in the later stages of normal development the course is ultimately described by the diffusion-equation alone.

A. D.

290. *Chemical Action of Light.* **P. Villard.** (Journ. de Physique, 4. pp. 619–628, Sept., 1905.)—In opposition to Guébhard [see Abstract No. 1560 (1905)] the author maintains that (1) printing-out paper, faintly darkened, has the darkening continued by the yellow of the spectrum, while fresh paper is not acted upon by it; and if the darkening be distinct it is bleached again by the red, about line A; (2) that gelatino-chloride plates, having no free nitrate of silver, present no continuing action under yellow light, but show under red rays, A down to $\lambda = 920$, destruction of a developable image; (3) that gelatino-bromide plates present the same destructive effect of the red rays from line B downwards. In Guébhard's experiments with yellow glass, the yellow light is not monochromatic, but the continuing action of the yellow rays predominates; and if the red rays be cut out by superposing a piece of green glass, the effect is much better, while if red glass be super-

posed instead, the continuing action is much less marked, or may be replaced by a destructive action. Destructive effect under yellow glass is always due to extreme red and infra-red rays which have traversed that glass, and these rays tend to destroy the impression as it is being produced by other rays. The infra-red part of a spectrum negative is always clear of fog, whatever be the time of exposure. Spectrum experiments are far more conclusive than those under coloured glass. The rule is that the destructive effect restores the sensitiveness in respect to those particular rays which had first caused the impression. A. D.

291. *Absorption Spectra of the Chlorine Acids.* **B. Kaebitz.** (Beibl. Ann. d. Physik, 29. 17. pp. 869–870, 1905. Extract of Bonn Dissertation, 1904.)—The spectra of the following compounds were observed: CrO_2Cl_2, ClO_2, Cl_2O, $HClO_3$, $HClO$, and $HClO_4$. CrO_2Cl_2 shows in the state of vapour 36 bands which can be arranged in 5 series. Cl_2O and ClO_2 give the same spectrum, consisting of sharply-defined bands, which can be resolved into lines. There are 65 bands between $\lambda = 4800$ and $\lambda = 3736$. The author considers that Cl_2O decomposes into Cl_2 and ClO_2. The acids only show general absorption. E. C. C. B.

292. *Absorption Spectra of Vapours.* **W. Friederichs.** (Zeitschr. Wiss. Phot. 3. pp. 154–164, May, 1905. Extract of Bonn Dissertation, 1905.)—The author has examined the absorption spectra of iodine, $TeCl_2$, $MnCl_4$, and benzene. In the case of iodine the effect of temperature was observed, the iodine being heated to 900° in quartz tubes. It was found that the bands weaken with increasing temperature, and finally disappear. In the spectrum of $TeCl_2$, 15 bands were measured between $\lambda = 5000$ and $\lambda = 4000$, and 43 in the case of $MnCl_4$. Certain series with constant frequency-difference were noted in the latter case. In benzene 8 bands were measured, and were found to have consistently smaller wave-lengths than those measured by Hartley in the case of solutions of benzene [see next Abstract]. E. C. C. B.

293. *Ultra-violet Absorption Spectra of Aromatic Compounds.* Part I., **E. C. C. Baly** and **J. N. Collie.** Parts II. and III., **E. C. C. Baly** and **E. K. Ewbank.** (Chem. Soc., Journ. 87. pp. 1332–1360, Aug., 1905.)—Benzene presents seven absorption bands, the formation of which may be accounted for by there being seven, and only seven, possible different types of making and breaking linkings produced by the internal motions of the benzene molecule. The introduction of a single substituent group modifies the absorption spectrum of benzene, different types of absorption being produced according to the nature of the substituent group (alkyls, unsaturated nitrogen, oxidic or ketonic oxygen, &c.), and also according to their position. Unsaturated atoms in the δ-position produce no effect on the absorption. The mono- and di-hydric phenols are tautomeric substances in the sense that the phenolic hydrogen atoms are in the labile state, and this tautomerism is also present in the aminophenols; the absorption band produced by this tautomerism is situated in very nearly the same spectral region as the absorption bands which had their origin in the benzenoid structure of these compounds, so that it is not possible to determine the presence or absence of a labile hydrogen in the phenols by merely comparing the absorption spectra of the phenols with those of their methyl or ethyl ethers. In the derivatives of benzene with two saturated substituent groups, the absorption-curve of the para-compounds shows either more bands than the ortho- and meta-compounds or the same number of bands with a much greater persistence : the para-compound may therefore be regarded as the most symmetrical of the three ; *i.e.*, the internal motions of the benzene molecule are less disturbed by the para- than by the ortho- or meta-substitution. [See also correspondence in *Nature* (72. pp. 557–558, Oct. 5, and pp. 630–631, Oct. 26, 1905), between the authors and W. N. Hartley as to whether Hartley and Dobbie had found seven bands or only six, and as to an alleged eighth band reported by Friederichs (preceding Abstract).]

A. D.

294. *Method for investigating Metallic Spectra in Vacuum Tubes.* **E. Wiedemann** and **A. Wehnelt.** (Phys. Zeitschr. 6. p. 690, Oct. 26, 1905. Paper read before the Liége Congrès de Radiologie.)—If a red-hot piece of Pt-foil, covered with CaO, BaO, or CaO, be used for the kathode in a vacuum tube, a current of several amps. at 110–220 volts can be made to flow through the tube. [See Abstract No. 2672 (1904).] Under these circumstances the anode melts and volatilises, and the vapour is brilliantly illuminated by the discharge. This is most convenient for the investigation of the spectra of metals. E. C. C. B.

295. *Effect of Great Pressure on Lines of the Arc Spectrum of Iron.* **W. J. Humphreys.** (Astrophys. Journ. 22. pp. 217–219, Oct., 1905.)—The author finds that under a pressure of 87 atmospheres the tendency of certain lines in the arc spectrum of iron to reverse is very much greater than under ordinary pressures. Further, many lines spread out and become diffused, and at the same time show considerable displacement towards the red. Up to the present only the region between $\lambda = 3900$ and $\lambda = 4337$ has been investigated.

E. C. C. B.

296. *Spectrum of the Luminescence from Crystals of Radium Bromide.* **F. Himstedt** and **G. Meyer.** (Phys. Zeitschr. 6. pp. 688–689, Oct. 26, 1905. Paper read before the Liége Congrès de Radiologie.)—On examining the photographs of the spectrum of the light from radium bromide crystals, it was found that the bands of the nitrogen spectrum extended beyond the limits of the crystals, that is to say the nitrogen immediately surrounding the crystals was glowing. This halo was not detected in the case of any other gas. E. C. C. B.

297. *Doppler-effect exhibited by Canal Rays, and the Spectrum of Positive Ions.* **J. Stark.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 5. pp. 459–471, 1905. Phys. Zeitschr. 6. pp. 892–897, Dec. 15, 1905. Écl. Électr. 46. pp. 56–58, Jan. 13, 1906.)—The author has previously put forward the view that the rays giving the line spectra originate in the free positive atomic ions of the radiating gas [see Abstract No. 1210 (1905)], and therefore it would follow that a stream of positive ions having high velocity should exhibit the Doppler-effect, the lines of the spectrum, being produced by light received in the direction of the stream, being displaced towards the violet or the red according to whether the stream is flowing towards or away from the spectroscope. The gas employed is hydrogen, and the spectroscope is placed to receive the light travelling normally to the canal rays and then in their direction. In the latter case the lines are doubled, the new line being displaced towards the violet; it has a sharp edge towards the violet and fades away towards the red, the reason being that the ions constituting the canal rays have velocities varying from a maximum (given by $\epsilon\delta V = \frac{1}{2}\mu v^2$) downwards. From the expression of Doppler's principle $\lambda_n - \lambda_p = \lambda_n v/c$, where λ_n and λ_p are the wave-lengths in "normal" and "parallel" directions respectively, v the velocity of the ions and c the velocity of light, it is seen that $(\lambda_n - \lambda_p)/\lambda_n$ should be constant for all the lines, and this is found to be the case. That the band spectrum originates with the neutral atoms and not the ions is shown by the fact that there is no Doppler-effect in this case. The author then discusses the effect of pressure on the line spectra, and deduces further evidence in support of his theory that the positive ions emit line spectra. The paper closes with a historical section dealing with the above question, in which the conclusions of P. Lenard [see Abstract No. 533 (1904)], drawn from experiments on vapours in the electric arc, that the lines of the first series are only emitted by the outer layer of the arc, are criticised on the grounds that these rays are more copiously emitted by the inner layers which are at higher temperature, but are strongly absorbed by the outer layers of lower temperature. Thus the author places more reliance on his evidence for the positive ions as emitters of the line spectrum, drawn from the evidence of the Doppler-effect exhibited by the canal rays, than upon the conclusion of P. Lenard that this spectrum is emitted by the neutral molecules, arrived at by studying the arc, and the migration of metallic ions in flames. S. G. S.

298. *Limits of Visibility of Fluorescence.* **W. Spring.** (Bull. Acad. Roy. Belg. pp. 201–211, 1905. Receuil trav. chim. 24. pp. 297–304, 1905.)—The amount of fluorescein or eosin in solution in optically transparent water when the fluorescence becomes invisible in daylight is 10^{-8} gm. per c.cm., and is only 10^{-15} gm. per c.cm. when the fluorescence is just visible at the apex of a concentrated beam from an arc lamp. The area of liquid illuminated must, it is found, be at least 1 sq. mm., to render the fluorescence visible. From these results the value $2{\cdot}5 \times 10^{-21}$ gm. is derived for the weight of the atom of hydrogen (representing only the higher limit), which is an approximation to, but smaller than, the values obtained by Maxwell, Kelvin, de Heen, and others, from other considerations. L. H. W.

299. *Fluorescence of Sodium Vapour and the Resonance Radiation of Electrons.* **R. W. Wood.** (Phil. Mag. 10. pp. 513–525, Nov., 1905. Communicated by the Physical Soc. Phys. Zeitschr. 6. pp. 903–910, Dec. 15, 1905.)—A continuation of the author's investigation into the fluorescence of sodium vapour under the influence of various exciting waves [see Abstract No. 2177 (1905)]. A seamless steel tube was used, 3 in. in diam. and 30 in. long, fitted at each end with a glass window; inside this tube was a steel retort which contained the sodium. This retort was made by fitting two steel discs to a short length of tubing which could just slip into the large tube. In the circular ends to this retort were cut oval apertures through which the beam of light could pass. Briefly, the phenomena observed may be described thus: First, the yellow-green-blue fluorescence which is excited by blue-violet light; this is a banded spectrum, the wave-lengths of which are given in the paper. This spectrum may be divided roughly into three parts. A, from 571–500, made up of regular spaced lines; B, from 500–477, made up of irregularly spaced lines, often hazy on one side; and C, from 477–468, made up of very broad lines spaced with a fair amount of regularity. The second fluorescence spectrum is that of the D lines themselves, for the author

has succeeded in making the vapour fluoresce with the same wave-length as the light which it is absorbing. A very powerful beam of light from an oxyhydrogen-sodium flame is directed on to the sodium vapour, when the vapour at once glows with a yellow glow which shows the D lines. The third fluorescence spectrum is one in the red, which also consists of bands. The author has also studied the yellow-green-blue fluorescence, using the monochromatic illuminator and varying the wave-length of the exciting light. As the stimulating wave-length is increased, the region of maximum fluorescence moves towards the blue. Radiations can be detected both above and below the exciting wave-length, so that Stokes's law does not hold. As the methods of experiment were improved it became possible to narrow the slit of the monochromatic illuminator to very small dimensions. It was then found that the slightest change in the wave-length of the exciting light caused the lines in the fluorescence spectrum to flutter about in a most extraordinary manner. The author hopes to study these changes photographically; apparently over 100 changes can be observed when the exciting light changes from 450–550. E. C. C. B.

300. *Effects of Röntgen Rays on Different Metals.* **H. A. Bumstead.** (Amer. Journ. Sci. 21. pp. 1–24, Jan., 1906. Phil. Mag. 11. pp. 292–317, Feb., 1906.)—The effect produced in different metals when Röntgen rays were caused to strike them was investigated by a radiometer method. The object of the investigation was to find if Röntgen rays were able to cause atoms to break up. If this is the case, different substances are probably unequally susceptible to this effect, and thus an inequality would be found in the amount of heat produced when Röntgen rays are equally absorbed in different substances. It was shown by the experiments that when Röntgen rays are equally absorbed in lead and zinc approximately twice as much heat is generated in the lead as in the zinc. The author thinks that to account for this the only hypothesis not in conflict with experimental facts is that by means of Röntgen rays the atoms of certain elements may be artificially broken up, and that the energy thus liberated forms a part (and perhaps the greater part) of the energy which appears when the rays are absorbed by matter. J. J. S.

301. *Secondary Ionisation produced by β- and γ-Rays in Different Gases.* **G. Kučera.** (Ann. d. Physik, 18. 5. pp. 974–990, Dec. 28, 1905. Extract from the "Rozpravy" der böhm. Kaiser Franz Joseph-Akad. d. Wiss. in Prag.)—This is measured by the ions produced in various gases by different radiators. The results are given in tables. The secondary γ-radiation is a constant fraction of that produced by the γ- and β-ray secondary radiation. R. S. W.

302. *Radio-activity and Geophysical Phenomena.* **H. Nagaoka.** (Physico-Mathematical Soc., Tokyo, Proc. 2. 27. pp. 423–432, 1905.)—The radio-activity of air may be due to the escape of emanations from subterranean regions, to heat in the earth's interior causing the expulsion of negative ions from certain oxides, or to ions received from the sun. The examination of the smoke from the volcanoes is suggested as a source of information which will enable us to decide the question. The possibility of terrestrial magnetism being due to the rotation of the earth, the outer crust of which is electrified by the presence of ions escaping from the interior, is pointed out. Supposing that electromagnetic mass could be detected by a balance, it follows

that those atoms whose electrons are moving the most rapidly will be the heavier, and the ratio of the atomic weights will not be the ratio of the number of electrons. Deviations from Prout's law could thus be expected.
R. S. W.

303. *Radio-activity of the Products of Etna.* **G. T. Castorina.** (Boll. dell' Accad. Gioenia di Scienze Naturali in Catania, 84, 85. 1905. N. Cimento, 10. pp. 198–202, Sept., 1905.)—The apparatus of Elster and Geitel is modified, and the radio-activity of several earths determined. The ratio of the time-intervals for the deflected leaf of the electroscope to move over one or more scale divisions with air only present and with the substance present is taken as a measure of the radio-activity of the substance. The "pozzolane" (earths coloured by the action of lava) vary on this scale from 3·60 to 1·60, the earths from 3·13 to 1·67, and the sands and sandy tufi from 2·10 to 1·25 ; the clays, argillaceous earths and muds take intermediate positions in this classification. For a second set of experiments the apparatus is made more sensitive, and the effect of drying the specimens in various ways is investigated. By drying in the open air no change in radio-activity is produced, but on drying by heating the radio-activity is rapidly lost, only to be completely regained after an interval of 8 days. On treating the earth with concentrated solution of HCl and filtering, the residue has diminished radio-activity, but this is completely regained in about 15 days ; the solution is entirely inactive. The volcanic products, arranged in order of increasing radio-activity, are : rocks, sands, sandy tufi, clay, and argillaceous earths, mud, organic earths, and pozzolane. S. G. S.

304. *Radium A, B, and C.* **H. W. Schmidt.** (Phys. Zeitschr. 6. pp. 897–903, Dec. 15, 1905. Phys. Inst., Giessen, Nov. 17, 1905.)—From their experiments on the disappearance of induced radio-activity on heating [see Abstract No. 1360 (1904)], P. Curie and J. Danne came to the conclusion that the rate of de-activation depends upon the temperature, but the author explains the effect on the assumption that radium B is more volatile than radium C, and shows that the effect of temperature may be entirely due to this ; he also thinks that the change from radium B to radium C goes on more slowly than that from radium C to radium D. In the second part of the paper the author describes an experiment in which an Al sheet is activated by a radium solution, and then placed near the dispersion conductor. A series of observations are made, with the Al surrounded by sheets of Al of varying thickness. The intensity of radiation reaches a maximum at times which vary with the thickness of the absorbing layer ; the time of maximum at first falls slowly with increasing thickness, then very rapidly, reaching a minimum at 0·05 mm., and then rising. The author explains these results by supposing a radiation to take place during the transformation from radium B to radium C, the radiation emitted being slightly more penetrating than the α-rays and much less than the β-rays. This is contrary to the conclusion of Rutherford, that this change is "rayless." S. G. S.

305. *Radio-activity and the Earth's Internal Heat.* **R. J. Strutt.** (Nature, 73. p. 173, Dec. 21, 1905.)—Rutherford has calculated that the radio-activity required to compensate for the earth's internal heat is much exceeded by the (apparent) activity of ordinary materials, as determined by Strutt. Thus the smallest activity Strutt observed was about 10^{-4} times that of uranium nitrate,

or 7×10^{-11} times that of radium; whereas the amount of activity, per unit mass of the earth, required to compensate for the loss of internal heat is only $4 \cdot 6 \times 10^{-14}$, or less than one-thousandth part of the activity computed to be actually there. The author suggests that the simplest way out of the difficulty is to suppose that the apparent radio-activity of ordinary materials is not a volume effect of the same nature as that of radium, but that it is merely a superficial effect of quite a different kind, and only occurring at an exposed surface. J. J. S.

306. *Absorption of α-Rays.* **R. K. McClung.** (Phil. Mag. 11. pp. 131–142, Jan., 1906.)—Bragg and Kleeman have shown that the α-rays have a definite range in air provided they are homogeneous. As they used radium in radio-active equilibrium, at least four sets of α-particles were present. The author uses their method, but as source he takes a wire that has been rendered active by exposure to emanation. After a short time the only source of α-rays is the radium C on the wire. The results of Bragg and Kleeman are verified: the range in air is 6·8 cm. After interposing different layers of aluminium-foil the range is again measured. It is deduced that one layer of foil 0·00031 cm. thick is equivalent, in absorbing power, to 0·52 cm. of air. These results agree well with those of Rutherford, obtained by another method, and may be looked upon as supporting his view that phosphorescence, &c., are due in the first instance to ionisation. R. S. W.

307. *Decay of Active Deposit from Radium.* **H. L. Bronson.** (Phil. Mag. 11. pp. 143–153, Jan., 1906.)—The decay is measured by the method already described by the author [Abstracts Nos. 816 and 1586 (1905)]. It appears to be very convenient in practice. It is found that temperatures between 700° and 1,100° do not permanently affect the rate of decay. Radium B and C are unequally volatile; they may therefore be separated by heat. Making use of this fact, it is found that B, and not C, has the longer decay period. The times taken to fall to half value which have been given previously by Rutherford and others are 28 and 21 min. The author finds that 26 and 19 min. are much nearer to the true values. R. S. W.

308. *Properties of the α-Rays from Radium.* **E. Rutherford.** (Phil. Mag. 11. pp. 166–176, Jan., 1906.)—Becquerel has questioned the views of Rutherford and Bragg that the α-rays from radium are not homogeneous, and that their velocity is altered by passing them through layers of aluminium-foil [Abstract No. 2062 (1905)]. Rutherford's experiments, here described, conclusively uphold his own views, and he further shows that Becquerel's experimental results can be simply explained by the same theory. The α-rays from one half of an active wire in an evacuated space pass through aluminium; from the other half they proceed without obstruction to a photographic plate. An image of a fine slit is thus obtained both with and without a magnetic field acting on the rays. The deviation so produced is much greater for those rays which have passed through aluminium. If a salt of radium is used instead of the active wire, dispersion of the rays is clearly shown, proving that they are not homogeneous. For the author's quite simple explanation of Becquerel's results the original paper should be referred to. R. S. W.

REFERENCES.

309. *Determining Magnification and Field of a Telescope.* **E. Haudié.** (Soc. Franç. Phys., Bull. 3. pp. 425–429, 1905.)—The magnification of any telescope, Galilean or astronomical, is obtained by the aid of a camera. Any distant object may be used for the purposes of comparison, no special "mire" being required. It is sufficient to have a divided scale on the ground-glass with which to measure successively the two images to be compared. G. E. A.

310. *Magnifying Power of Microscopic Objectives.* **L. Malassez.** (Comptes Rendus, 141. pp. 1004–1006, Dec. 11, 1905.)—The magnifying power is expressed as the product of the distance of the image from the posterior focus into the potency of the lens. From this it is shown how, with two objectives, the one with the smaller potency may yet have the larger magnification. G. E. A.

311. *Doubling of the Lines in the Abbe Experiments.* **J. Rheinberg.** (Quekett Club, Journ. 9. No. 56. pp. 173–174, April, 1905.)—By using a grating as an object the doubling or absence of doubling of the lines can be shown by a slight transverse motion of the object, the point being that the effect is due to the object and not to the diaphragm placed in the back focal plane of the objective. G. E. A.

312. *Influence on Images of Gratings of Phase-differences amongst their Spectra.* **J. Rheinberg.** (Roy. Microscop. Soc., Journ. pp. 152–155, 1905.)—The above is illustrated by means of photographs of a reciprocal grating in the upper half of which the ratio width of slit : width of bar is as 1 : 2, and in the lower half is 2 : 1. The character of the photograph depends entirely on the portion of the central diffraction image chosen to illuminate the photographic plate. G. E. A.

313. *Optical Behaviour of Active Crystals.* **W. Voigt.** (Ann. d. Physik, 18. 4. pp. 645–694, Dec. 12, 1905.)—An elaborate paper, mathematical, descriptive and experimental, in which the author deals with the explanation of the optical behaviour of uniaxial and biaxial crystals, especially as to the facts of conical refraction. [See also Abstracts Nos. 31 (1902), 528 (1904), and 1408 (1905).] E. H. B.

314. *Rainbow due to Circular Light Source.* **K. Aichi** and **T. Tanakadate.** (Physico-Mathematical Soc., Tokyo, Proc. 2. 27. pp. 417–422, 1905.)—The authors reply to a criticism by Pernter on a former paper of theirs. Pernter's integration only took into consideration the intensity in the plane which contains the centre of the source, the centre of the drop, and the observer's eye, so that it holds perfectly good for the case of a cylinder illuminated from a straight slit, but not for a sphere with a circular source. [See also Abstract No. 93 (1905).] C. P. B.

315. *Photography the Servant of Science.* **C. Jones.** (Photographic Journ. 45. pp. 359–366, Nov., 1905. Eighth Traill Taylor memorial lecture.)—Details of photographic procedure are dealt with, such as affect the engineer, geologist, spectroscopist, &c. With regard to the lens, it is shown how, without using costly apparatus, that may be tested as to truth of outline of image, extent of image, fineness of definition and absence of false images and lights. The remaining part of the paper deals with estimation of sensitiveness and with development and intensification. G. E. A.

316. *Reversal of Bands.* **W. J. Humphreys.** (Astrophys. Journ. 22. pp. 220–221, Oct., 1905.)—The author has observed the reversal of certain bands in the spectra of the fluorides of calcium, strontium, and barium in the arc spectra of these substances at atmospheric pressure. E. C. C. B.

317. *Magnetic Double Refraction of Sodium Vapour.* **J. Geest.** (Archives Néerlandaises, 10. pp. 291–335, 1905. Abstract of Dissertation, Amsterdam, 1904.)—A fuller treatment of the subject already dealt with in Abstract No. 724 (1905).

318. *Some Phosphorescent Spectra, indicating the Existence of New Elements.* **W. Crookes.** (Chem. News, 92. pp. 273–274, Dec. 15, 1905.)—In the course of his experiments upon the phosphorescence spectra of rare earths the author claims to have established the existence of two new elements which he calls ionium and incognitum. He bases his deductions upon the appearance of two groups of bands each of which can be separately concentrated by process of fractionation. [See, however, next Abstract.] E. C. C. B.

319. *Victorium and the Ultra-violet Phosphorescence of Gadolinium.* **G. Urbain.** (Comptes Rendus, 141. pp. 954–958, Dec. 4, 1905.)—The author, in reference to Crookes's discovery of the ultra-violet band in the phosphorescent spectrum of gadolinium, and his attributing it to a new element victorium, has made a careful series of experiments and has proved that this band is not due to another element but to gadolinium itself. E. C. C. B.

320. *Secondary Radiation from and Electrical Action produced by Röntgen Rays.* **G. Sagnac.** (Phys. Zeitschr. 7. pp. 41–50 and 50–56, Jan. 15, 1906. Paper read before the Liége Congrès de Radiologie. From the French.)—A summary is given of the methods of experimental investigation on the transformation of the Röntgen rays and the secondary radiation arising from them. As regards the electrical action of the rays, in all cases hitherto investigated ions or electrons in a gas or in a metal are liberated through the action of the Röntgen rays or their derivatives (secondary rays, tertiary rays, &c.). It is these ions and electrons which change the charge on the insulated body under investigation. J. J. S.

321. *Present Problems of Radio-activity.* **E. Rutherford.** (Archives des Sciences, 19. pp. 31–59, Jan., 1905.)—A general paper in which the most important problems in connection with radio-activity are considered, and the directions in which further research is needed pointed out.

322. *Radio-active Constituents of Wiesbaden Springs.* **F. Henrich** and **G. Bugge.** (Zeitschr. Angew. Chemie, 18. pp. 1011–1014, June 30, 1905.)—The gas and water from these springs has been previously dealt with [see Abstract No. 103 (1905)]. The deposit from the pipes is found to consist chiefly of aragonite and was radio-active, the activity not being lost when heated for several hours at 110° C. The gas disengaged on adding HCl is also radio-active. An examination was made of the separate fractions obtained from the deposit. The radio-activity of the water from the Adler spring as well as of the gas evolved is due to radium emanation. L. H. W.

323. *Radio-activity.* **C. Feliciani.** (Accad. Lincei, Atti, 14. pp. 674–681, Dec. 17, 1905.)—Observations as to the radio-activity of, and the radio-activity induced by, the incrustations formed at various mineral wells in Italy. They all contain thoria and probably contain radium. A. D.

324. *Radio-activity of the Air from "Breathing Wells."* **E. Sarasin.** (Phys. Zeitschr. 6. pp. 708–709, Oct. 26, 1905. Paper read before the Liége Congrès de Radiologie. From the French.)—The author expected that the air emerging intermittently from these wells would be strongly radio-active. Several measurements on such a well in the village of Meyrin, near Genf, Place de la Croix, by means of an Ebert aspiration electrometer were made. The air is found to be more than ten times as radio-active as ordinary atmospheric air. S. G. S.

HEAT.

325. *Neumann's Method of determining Heat-conductivity.* **G. Glage.** (Ann. d. Physik, 18. 5. pp. 904–940, Dec. 28, 1905. Extract from Königsberger Dissertation.)—An account is given of F. E. Neumann's original method, which consists in reading from time to time the temperatures of particular points of a uniform bar or rod that has for some time been heated at one point and is then allowed to cool by radiation, and it is pointed out—what is not generally recognised—that this method is really independent of the initial condition of the bar when it begins to cool. The simple theory is first given, then the influence of sectional size of the rod is examined, and also that of the dependence on temperature of the conductivities and specific heat. For rings it is shown that the best points at which temperatures should be taken are distant from the heated point by one-eighth and five-eighths of the ring's length respectively. A full account of the mode of heating is given, and also of electrically determining the actual temperatures, which is done by a process of compensation, it being found that much greater exactness is thus obtained than by directly measuring electrically the sum and difference of the temperatures at the two points examined, as Neumann did. Variation of the state of the surface of the rod was not found to affect the determination of its conductivity, provided that the whole surface was treated alike. Experiments on rods give for 1,000 K in c.g.s. units, chiefly at 80° C.: Silver 994, copper 932 and 880, brass 295, zinc 284, iron 158 and 149, tin 149, steel 110, lead 86. R. E. B.

326. *Assmann's Method of determining the Ratio of the Specific Heats of a Gas.* **B. Hartmann.** (Ann. d. Physik, 18. 2. pp. 252–298, Nov. 7, 1905. Extract from the Göttinger Dissertation.)—In this method the ratio is deduced from the periodic time of oscillation of mercury in a U-tube with closed ends, which contains the gas in question. Assmann's theory is only roughly approximate: he neglects the effects of friction, both external and internal, on the mercury, which he takes to move in parallel layers, taking also the changes in the gas to be perfectly adiabatic. The author considers the case of a tube in the form of an anchor-ring, employing Riemann's ring-co-ordinates, and he tests his results by experiments in which the oscillations are photographically registered. He finds that the external friction near the free surfaces of the mercury produces such imperfectly defined conditions that the oscillations are not harmonic with a constant logarithmic decrement—this is experimentally obviated by coating these surfaces with concentrated H_2SO_4, which, as it were, oils the tube walls. He finds further that the effect of internal friction and of the friction against the tube walls is to increase the period of an oscillation, but that this frictional effect is negligible if the tube is sufficiently wide. He finds, lastly, that the interchange of heat between the gas and the tube is considerable, and that as it, for the most part, depends on convection, it cannot be satisfactorily prevented. For the last reason, therefore, the method is not unobjectionable. The means of the author's experimentally found values of K for air, CO_2, and hydrogen, are 1·4137, 1·3064, 1·4188, from which the individual values do not vary by more than four-tenths per cent. R. E. B.

327. *Specific Heat of Gases.* **S. Lussana.** (N. Cimento, 10. pp. 192–195, Sept., 1905.)—The results of Holborn and Austin [see Abstract No. 765 (1905)] are given, and the conclusion of these authors, that the rise in specific heat with temperature is so small as to be uncertain, is criticised on the grounds that, although small, there is a rise in all the cases under observation. The author then gives results of his own, which show that in the case of air the specific heat at constant pressure rises with the temperature, and, further, that the rate of increase rises with the temperature. It is then stated that these conclusions are in agreement with the experiments of other observers, except in the case of Witkowski, in which the specific heat falls with rising temperature; but the temperatures in Witkowski's experiments were much lower than in those of the other experimenters. The general conclusion reached is that the specific heat at constant pressure increases or decreases with rise in temperature according to whether the temperature is much above or is near the point of liquefaction, and that with increasing temperature the rate of rise of specific heat increases. Also the specific heat rises with increasing pressure to a maximum and then falls. S. G. S.

328. *Specific Heat of Superheated Steam.* **L. Holborn** and **F. Henning.** (Ann. d. Physik, 18. 4. pp. 739–756, Dec. 12, 1905. Communication from the Physikal.-Techn. Reichsanstalt.)—A method akin to that used for gases [see Abstract No. 765 (1905)] was used, but paraffin oil kept constantly above 100° C. was used in the calorimeter instead of water, so that condensation of the steam did not complicate the measures. The heating was done electrically, the temperature-intervals employed were 110°–270°, 110°–440°, 110°–620°, 110°–820° C., and the experiments with steam were alternated with experiments on air, the ratio of the specific heats of steam and air being thus determined; this was found to be 1·940, 1·958, 1·946, 1·998 for the above intervals respectively. Thus the value of the specific heat found previously for air gives for the mean specific heat of steam between 0° and θ° under one atmosphere $C = 0{\cdot}4460\,(1 + 0{\cdot}000096\,\theta)$. R. E. B.

329. *Energy and Specific Heat near the Critical Temperature.* **M. Reinganum.** (Ann. d. Physik, 18. 5. pp. 1008–1019, Dec. 28, 1905.)—From data given by Ramsay and Young for ethyl ether, by Amagat for CO_2 and ethyl, and by Young for isopentane at about 10° above their critical points, the values of $a \equiv v^2(T\partial p/\partial T - p)$ are calculated; these are found to decrease as the density increases, assuming a minimum value (which is about half of that for high rarefaction) at a volume which is about three-quarters of the critical volume. Since $(\partial a/\partial T)_v = v^2 T\partial^2 p/\partial T^2 = v^2(\partial k/\partial v)_T$, where k is the isometric specific heat, the variation of a with T and the values of k are theoretically deducible from the above data; but these are not sufficiently exact. It appears, however, that, at least for isopentane, for each specific volume within a range including the critical volume, k has a maximum value for some particular temperature. It is further concluded that the relation $a + m(\partial a/\partial T)_v = n$ holds approximately, where m, n are constants; this requires $(a - n)e^{T/m}$ to be a function of v only, which on a certain assumption is of the form $\surd(\alpha - \beta/v + \gamma/v^2)$ and gives determinable expressions for k and the intrinsic energy. R. E. B.

330. *Radiation from Platinum at High Temperatures.* **G. K. Burgess.** (Bureau of Standards, Bull. 1. 3. pp. 443–447, Nov., 1905. Écl. Électr. 46.

pp. 182–184, Feb. 3, 1906.)—If θ_1 is the reciprocal of the temperature of a black body, and θ_2 that of any other substance at the same photometric brightness, it is shown that $\theta_1 = \alpha\theta_2 + \beta$, where α and β are constants whose physical interpretation is here given. As the equation is linear, a knowledge of the black-body temperature and true temperature at two points only is sufficient to define completely the departure of the radiation of a given substance from that of a black body throughout the entire temperature scale, provided no chemical change takes place. R. S. W.

331. *Radiation of Heat in a System of Bodies at a Uniform Temperature.* **H. A. Lorentz.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 345–360, Oct. 12; and pp. 408–412, Nov. 8, 1905. Proc. 8. pp. 401–421, Nov. 22, 1905.)—Instead of developing a complete theory of the motions of electrons to which radiation-phenomena may in all probability be ascribed—a very difficult task—the author supposes the radiation to be produced by certain periodic e.m.f.'s acting in the elements of volume of ponderable bodies. For details of the calculations, in which complex vectors are employed, the paper itself must be referred to. The vibrations set up in an unlimited homogeneous and isotropic body subjected to given electromotive and magnetomotive forces changing with a given frequency are first examined and the equation of energy is established; the absorption by a very thin plate surrounded by ether on both sides and receiving a beam of rays normally is then considered and from this its normal radiation is deduced, the intensity to be ascribed to the e.m.f.'s in order to produce this effect being next calculated; from this a general hypothesis concerning the e.m.f.'s is deduced, and it is shown that if these e.m.f.'s were applied the condition required for the equilibrium of radiation would always be fulfilled. With the deduced arrangement both the electric and magnetic vibrations take place with equal intensities in all directions; the two kinds of energy are distributed over the body with equal densities, and these densities are inversely proportional to the cube of the speed of propagation. The calculated intensities of the e.m.f.'s are inversely as the square roots of the magnitudes of the elements of volume: this shows that these e.m.f.'s have no real existence and that the suggested mechanism is only an imaginary one by which the effects of the real mechanism of radiation could be produced. R. E. B.

332. *Laws of Radiation.* **J. H. Jeans.** (Roy. Soc., Proc. Ser. A. 76. pp. 545–552, Dec. 6, 1905.)—On the assumption that the radiation of a body is chiefly due to the rapid motion of free electrons within the body and from consideration of the physical dimensions of the magnitudes concerned, the author finds $\lambda^{-4}Tf(\lambda T)d\lambda$ for the law of radiation of a perfect radiator, *i.e.*, for the energy of radiation per unit volume of wave-length between λ and $\lambda + d\lambda$ emitted by a body at temperature T, that body being such that at all temperatures its total radiation is a maximum. This is in accordance with Stefan's law and also with Wien's. From Lorentz's analysis it may be inferred that the function $f(\lambda T)$ is such as to approximate to a constant value for large values of λT, and it must further decrease very rapidly as λ decreases (like the function $\epsilon^{-c/\lambda T}$). R. E. B.

REFERENCE.

333. *Mechanical Equivalent of Combustion.* **M. Cantor.** (Phys. Zeitschr. 6. pp. 805–806, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—A discussion of the phenomena of combustion, its heat equivalent, and the construction of a rational combustion motor. E. H. B.

SOUND.

334. *Whistling Vibration of a Drop.* **T. Terada.** (Physico-Mathematical Soc., Tokyo, Proc. 2. 26. pp. 407–412, 1905.)—A capillary end is fused in a glass tube 5 mm. in internal diam., and the other end is connected to an air-bag of considerable capacity, which is pressed by a constant weight. On wetting the nozzle with some liquid, such as water or olive oil, the air, in blowing through the liquid, produces a musical note of definite pitch, the latter depending upon the dimensions of the nozzle, as well as the quantity and nature of the liquid. A microscopic examination shows that the liquid bubble is wide open while the note is sounding, and that the note is due to the vibration of the edges of the liquid. The pitch varies nearly inversely as the radius of the aperture, and inversely as the square root of the density of the liquid. It varies directly as the square root of the capillary constant. When the liquid is magnetic, like a solution of ferric chloride, the establishment of a magnetic field about it immediately lowers the pitch in some cases, and raises it in others. This phenomenon may be useful for demonstrating the magnetism of liquids, or for exploring magnetic fields otherwise inaccessible. E. E. F.

335. *Reflection of Sound at a Paraboloid.* **H. J. Sharpe.** (Cambridge Phil. Soc., Proc. 13. pp. 133–147, Oct. 25, 1905.)—The author continues his discussion of the equation—

$$V \, . \, d^2V/dv^2 + dV/dv + (p^2 v \pm A)V = 0.$$

In the first paper [see Abstract No. 845 (1900)], A was supposed to be large. In the present paper, A is supposed to vanish. This case has the advantage that it can be worked out to any degree of accuracy required. He shows that when the paraboloid reflects the sound from a source on the axis, there are two foci of reflection, situated on either side of the geometrical focus. The velocities at these foci are equal and opposite. As the pitch of the note rises, these two foci approach nearer and nearer to each other. The sound magnification produced by a sound-sending reflector is measured by $(p^3/2\pi v_0)^{\frac{1}{2}}$. Thus, if the strength of the source is constant, the magnification varies as $\sqrt{\text{pitch}^3}$. E. E. F.

336. *Distinguishing Tone Intensities.* **H. Zwaardemaker.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 396–400, Nov. 8, 1905. Proc. 8. pp. 421–426, Nov. 22, 1905.)—This is an account of experiments made by A. Deenik. The ends of two hearing-tubes being movable round a circle whose axis is that of a tuning-fork, one is placed in the plane of maximum sound and the other is displaced in the direction of Kiessling's interference-plane till a distinct difference in the intensity of the sounds is noted, and this position is determined from the average of ten observations. Similar experiments were made with organ-pipes. With tuning-forks Weber's law is found to be valuable when taken in a general way, but it is not exact for sounds of medium and weak intensities. The experiments with organ-pipes show that the most favourable "Unterschiedsschwelle" occurs with c^4, and that the power of distinguishing difference in intensities decreases regularly as the sounds differ from this note on both sides of it. R. E. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

337. *Constitution of the Electron.* **W. Kaufmann.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 45. pp. 949–956, Nov. 16, 1905.)—The amount by which the apparent mass of the electron increases with increasing velocity agrees well with M. Abraham's assumption that the electron is a rigid sphere uniformly charged over its surface or throughout its volume [see Abstracts Nos. 2111 (1901), 685 (1902), 457 and 1411 (1903)]. Now Lorentz has shown that a similar agreement may be obtained by supposing that the electron is flattened in the direction of motion. The author has therefore repeated the measurements made on the β-rays of radium, with greatly increased precision, in order to discriminate between the theories of Abraham and Lorentz, and also those of Einstein, who formally agrees with Lorentz, and of Bucherer [Abstract No. 174 (1906)], who assumes an incompressible but deformable electron. The author determines the constants of the deflection curves from the three theories, and compares them with the constants of the actual photographic curve, on the basis of S. Simon's value for the ratio e/m [Abstract No. 118 (1900)]. The comparison shows a discrepancy of 10·4 per cent. in the case of Lorentz, 3·5 per cent. for Abraham, and 2·8 per cent. for Bucherer, all in the same sense. The author concludes against Lorentz's assumptions at all events. E. E. F.

338. *Gravitation and Electromagnetism.* **R. Gans.** (Phys. Zeitschr. 6. pp. 803–805, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—The electron theory due to Lorentz connects the phenomena of electricity, magnetism, optics, and radiant heat, but leaves gravitation outside the region treated. But without doubt our view of physical phenomena would be simplified if gravitation could be put upon the same basis. Lorentz has accordingly endeavoured to make his equations embrace gravitation also. To do this the field equations were left unaltered, but those for the mechanical forces modified so that the attractions of unlike charges should slightly exceed the repulsion of like charges. Thus there would result a net gravitational attraction between uncharged bodies. This line of thought is then followed up mathematically. References are also made to the theories of Drude for the Hall-effect [Abstract No. 1276 (1900)], of Heydweiller; concerning the possible change of weight with chemical reaction if rotatory motions of positive electrons occur [Abstract No. 1760 (1901)], and of Wien as to the electromagnetic nature of inertia [Abstract No. 765 (1901)]. E. H. B.

339. *Electrostriction.* **G. Ercolini.** (N. Cimento, 10. pp. 185–191, Sept., 1905.)—Rubber tubes are experimented upon; the tube forms a condenser of which the coatings consist of water inside and outside the tube. The elongation is magnified by a lever and a mirror, the image of a scale produced by the mirror being observed by a scale and telescope. A movement of the end of the tube in the direction of elongation produces a deflection of 9 scale divisions. The tube is stretched by amounts varying from 20 to 50 per cent., and the electrostriction in various conditions determined. The coatings of the condenser are maintained at different potentials by means of

a small Wimshurst machine. It is found that although the condenser is warmed in the act of charging, the elongation produced on this account is much less than that which is actually produced by the electric field, and hence the phenomenon of electrostriction really occurs in this case. [See Abstracts Nos. 2440 (1900) and 700 (1902).] S. G. S.

340. *Dimensions of Electric and Magnetic Quantities.* **L. G. Muaux.** (Écl. Électr. 44. pp. 241–249, Aug. 19, 1905.)—The existing electromagnetic system is very severely criticised. For generalisation, assume that $m = L^x M^y T^z$ and $q = L^{x'} M^{y'} T^{z'}$: a table is worked out on this basis, including expressions for K and μ. From symmetry, $x = x'$, $y = y'$, $z = z'$; and further give the strength of current the dimensions of a velocity : then $x = x' = 1$, $y = y' = 0$, and $z = z' = 0$, and all the dimensions work out with remarkable simplicity; $K = [LM/T^2]$ and $\mu = [M/T]$; electromotive and magnetomotive forces have dimensions $[LM/T^2]$, a force ; μi has $[LM/T^2]$, a force ; resistance $[LM/T]$, a friction ; self-induction and mutual induction $[M]$, a mass ; EI is the product of a force by a velocity = energy ; and so forth. Hydrodynamical analogies work out equally well. **F. Emde.** (Écl. Électr. 45. pp. 321–324, Dec. 2, 1905.)—Emde criticises Muaux's scheme ; there is no reason why the inductivity should correspond to a mass rather than to a moment of inertia, or why a current should correspond to a velocity. A. D.

341. *Molecular Magnetism.* **W. Peddie.** (Roy. Soc. Edinburgh, Proc. 25. pp. 1025–1059, 1904–1905.)—The principle of molecular magnets stated by Poisson and Weber, and recently developed by Ewing, is here considered from the modern standpoint, viz., the crystalline structure of all solids. The experimental work of Weiss on magnetite (a cubic crystalline form) and the formulæ deduced from it by Wallerant form the starting-point for the author's mathematical treatment of the subject. Some of his conclusions are : (1) The theory of molecular magnetism leads to results in general agreement with observed results. (2) Wallerant's formula is applicable but needs special interpretation. (3) Investigation of other assemblages of molecules with cubic symmetry may lead to a discrimination of molecular arrangement. (4) The results obtained may, perhaps, be used for a medium consisting of randomly arranged crystalline particles. (5) The Boscovichian theory of the constitution of matter is capable of extension so as to include application to magnetic properties. P. E. S.

342. *Theory of Magnetism.* **P. Langevin.** (Journ. de Physique, 4. pp. 678–693, Oct., 1905. Electrician, 56. pp. 108–109, Nov. 3, and pp. 141–143, Nov. 10, 1905. Abstract.)—The Ampère molecular currents suggest that they are due to charged electrons gravitating in closed orbits; these would produce magnetic fields analogous to those produced by current-elements, of strength proportional to the charge of the electron and to its velocity, and a molecule would contain as many of these currents as there were electrons in movement. The resultant might be a magnetic moment = 0 if the molecule were symmetrical enough : if not, there will be a resultant magnetic moment. If the summed-up magnetic moment = 0, an exterior magnetic field will diamagnetically polarise all the molecules ; if it be not = 0, there is a superposition, upon the diamagnetic effect, of an orientation of the magnetic molecules by the exterior field ; the result is paramagnetism if the mutual intermolecular actions are negligible (gases, solutions), ferromagnetism where these interactions play a leading part. When paramagnetism does appear, it

is enormous in comparison with the initial diamagnetism, and masks it completely. The exterior magnetic field modifies the movements of all the electrons in their orbits so as to favour a diamagnetic effect, which is, however, always extremely small, and cannot modify the magnetic moments of the currents by more than 1 per cent. This last conclusion is supported by the smallness of the Zeeman-effect associated with the diamagnetic condition. The generality of the Zeeman-effect proves the generality of the diamagnetic effect of an exterior magnetic field. The radius of the orbit is not changed, only the period of revolution in a manner corresponding to Zeeman phenomena. The current-elements act like circuits of no resistance and of moderate self-induction, provided that all the inertia of the electrons is electromagnetic in its nature and all their kinetic energy is magnetic. The diamagnetic modification being extremely feeble, the current-elements may be considered as indeformable and appreciably constant in strength ; and thus we obtain a complete representation of the facts of paramagnetism and of the exchanges of energy between magnets and currents under the hypothesis that magnets are composed of circuits like the above, to which the ordinary laws of electrodynamics are rigorously applicable. The diamagnetic constant will not depend upon the temperature (which P. Curie has found to be the case), nor conversely. The smallness of the diamagnetic effect is a consequence of the smallness of the molecular dimensions. If the magnetic moment be not $=0$, the exterior field turns the molecules, a thermic agitation takes place, and the temperature becomes equalised throughout at a higher level ; but the paramagnetic susceptibility will vary inversely as the absolute temperature (which P. Curie has also found to be the case). These propositions have their analogies in gravitational problems concerning gases. The distribution of the different orientations of the molecules, in static equilibrium, will depend upon the potential magnetic energy together with the thermic agitation of the molecules, the molecules lying by preference with their axes in the direction of the field ; and the magnetic moment of the whole is directed parallel to the field and is the sum of the projections in that direction of the component moments. The heat of hysteresis is explicable on the same principles, introducing the mutual actions between molecular magnets ; and here we have analogies in the cohesion of liquids and mutual directive forces in crystals or in electrolytic deposits. A. D.

343. *Vertical Electric Currents in Atmosphere by Balloon Journey.* **H. Gerdien.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 240–251, and 5. pp. 447–458, 1905. Terrestrial Magnetism, 10. pp. 65–79, June, 1905.)—By means of the instrument described in the first paper, which is the latest form of that previously referred to [see Abstract No. 2661 (1904)], the free atmosphere was tested as to potential gradient and vertical currents up to heights of 6,000 m. during a balloon trip undertaken in August, 1905, between Berlin and Warsaw. The potential gradients in volts/m. are of the order 40 for heights of 1,730 m., but gradually fall off to about 8 for the greatest height reached, namely, 6,030 m. The density of the vertical conduction current in electrostatic units multiplied by 10^7 varies irregularly from 4 to 7, except for one value particularly low, 0·8. [See also Abstracts Nos. 820 and 2078 (1905).] E. H. B.

344. *Electrical Conductivity of Air at Sea.* **J. E. Burbank.** (Terrestrial Magnetism, 10. pp. 126–129, Sept., 1905.)—The determinations were made with Gerdien's instrument (see preceding Abstract). A large number of experiments were made at sea, the times, positions, conditions, and values obtained being given in tabular form. The values of the specific conductivity range from $0·05 \times 10^{-4}$ up to $2·45 \times 10^{-4}$. The most remarkable effects were obtained on July 8, 1905, when on passing into a thick fog the figures fell from 0·40 to 0·05, rising to 1·09 as the fog cleared. E. H. B.

345. *Atmospheric Electricity on Graham's Land.* **J. Rey.** (Comptes Rendus, 141. pp. 850–852, Nov. 20, 1905.)—The author made observations, with the aid of an Elster-Geitel electroscope and a Curie radium collector, during the French Antarctic Expedition of J. Charcot in Nov. and Dec., 1904, at a station near the flat shore and on the ocean ice. The electric field has a single diurnal period, the maximum at 2.30 p.m. and the minimum at 4.30 a.m. being both well pronounced; the average field is + 68·4 volts, the average amplitude of the variation 44 volts; with serene sky the field is weaker than with cloudy sky; the strong, warm north-east winds produce strong fields and double the maximum. Mists also increase the field strength; snowfall decreases it. The field is never negative. The absolute values are lower than those for temperate regions. This agrees with the observations made by Andrée, Lemström, and Biese in high northern latitudes. H. B.

346. *Ionisation of the Atmosphere during Total Solar Eclipse.* **C. Nordmann.** (Comptes Rendus, 141. pp. 945–948, Dec. 4, 1905, and 142. pp. 40–43, Jan. 2, 1906.)—Stationed at Philippeville, Algeria, the author made a series of determinations of the magnetic elements, the electric field of the atmosphere, and the ionisation of the air. For the ionisation experiments the apparatus was installed on the summit of a peak 160 m. high. The receiver was placed on a platform of thick lead, which it was hoped would diminish the direct action of the radio-active radiation from the sun on the volume of air under examination. The receiver for collecting the ions was of the type previously described by the author [Abstract No. 2267 (1904)]. It was hoped to screen off the influence of the atmospheric humidity on the mobility of the ordinary ions, and to collect not only these but the other ions of feeble mobility described by Langevin. As the apparatus intended for detecting negative ions was damaged, the positive electrification was alone measured, but previous experience has indicated that the behaviour of the two kinds is similar. With good weather, regular wind, clear air, and no cloud, the curves show a sharp daily periodicity, of which the maximum occurs near midday and the minima near sunrise and sunset. During the progress of the eclipse there was a progressive diminution of the ionisation, with a minimum about 40 min. after totality, followed by a gradual augmentation until fourth contact, after which the curve resumed its normal aspect. It thus appears that the definite effect of the eclipse on the ionisation affords support to the ideas of Lenard and Elster and Geitel that the solar radiation is one of the determining factors of atmospheric ionisation. C. P. B.

DISCHARGE AND OSCILLATIONS.

347. *Kathode Rays: Measurements.* **A. Becker.** (Ann. d. Physik, 17. 3. pp. 381–470, July 18, 1905.)—According to Abraham, $(\epsilon/\mu)_0 = 1·847 \times 10^7$ c.g.s.: ϵ/μ depends on the velocity of the radiations [Abstract No. 644 (1903)]. Measurements are made of absorption in different solids; and also in different

gases. In gases the law of mass-proportionality holds only approximately. Every atom of the gases investigated consists of a number of dynamides proportional to its weight, these dynamides being equal in weight and in charge, and each of them presenting a certain absorbent cross-section ; the remainder of the radiation passes by with its velocity unaltered. The theory of conducting molecules in a non-conducting medium is confirmed, but applied to dynamides instead of molecules. Differences between gases are due to differences in the moments of the dynamides (Lenard) considered as electrical double points, these moments being small in chemically inactive, and greater in active elements. The absorptive power of a gas is proportional to the refractive index less unity. With the exception of helium, the molecular cross-section (kinetic theory of gases) and the absorptive cross-section of the dynamides stand in a similar order of progressive magnitude. **G. E. Leithäuser.** (Ibid. 18. 2. pp. 410–412, Nov. 7.)—Remarks on the foregoing by Leithäuser, who finds the data similar to his own [Abstract No. 158 (1905)] but obtained by methods too summary. A. D.

348. *Energy of Kathode Rays.* **W. Wien.** (Ann. d. Physik, 18. 5. pp. 991–1007, Dec. 28, 1905. From the Wüllner Festschrift, with additions. Écl. Électr. 46. pp. 179–180, Feb. 3, 1906.)—The subject of the paper is (1) the heat-effect of Röntgen rays as compared with the energy of the exciting kathode rays, and (2) the energy of the secondary rays induced by Röntgen rays. Both bolometer and thermopile methods were employed. The energy of Röntgen rays is to that of the exciting kathode rays as 0·00135 : 1·0 by thermopile, or 0·00109 : 1·0 by bolometer methods. The energy of the Röntgen rays depends upon the voltage and upon the kind and the frequency of the interruptions. Calculation of the breadth of the impulse due to Röntgen rays gives the value, $1{\cdot}15 \times 10^{-10}$ cm. [Sommerfeld's value $1{\cdot}3 \times 10^{-8}$ cm. (Phys. Zeitschr. 2. p. 59, 1902) is too great.] The energy of Röntgen rays is almost wholly converted into heat upon impact ; the proportion of it found in the secondary rays radiating from the surface impinged upon is small, say $\frac{1}{500}$, for the absorption of kathode rays is much greater than that of Röntgen rays ; and it may be that the absorption of Röntgen rays may itself be largely due to the production of secondary rays which are absorbed before emergence through the free surface. But there is a difficulty in this, namely, that it is not easy to see how the high velocities of kathode radiations are caused by the impact of Röntgen rays, and it appears impossible that the secondary rays should be from the free electrons in metal which determine the conductivity. Perhaps it may be explained by assuming that the electrons in the atom are in a state of labile equilibrium between the attraction of positive atoms and the repulsion of negative electrons, and that the repeated impact of Röntgen rays drives an electron more into the sphere of repulsion of other electrons, so that it becomes actively repelled ; in which case the energy of secondary rays would be derived direct from atomic energy. If this were so, we might find that the heat which we measure and attribute to Röntgen rays may itself, being secondary radiation absorbed and converted into heat, be derived from the energy of the atoms, with corresponding alterations in the constitution of these. Or else the energy of the Röntgen radiations may be directly transformed into that of secondary rays within the atom, leaving the energy of the atom unaffected. The high velocities in question cannot pre-exist in the atom ; if they did, there would be so much loss of energy by radiation that the energy of atomic motion would very soon be dissipated. A. D.

349. *Action of Magnetic Field on Canal Rays.* **H. Pellat.** (Comptes Rendus, 141. pp. 1008–1010, Dec. 11, 1905.)—The canal rays were produced in a tube 1 m. long and 18 mm. in diam., with the anode at one end and the kathode, formed of a grating placed in front of a short cylinder touching the sides of the tube, at a distance of 18 cm. from the anode. The tube contained air, dried and free from CO_2, at a pressure of 0·04 mm. of Hg. When the tube is placed between the poles of an electromagnet, with its length at right angles to the field, a weak field causes a deviation of the thin luminous stream passing along the tube. On increasing the field, the beam increases in size, becomes nebulous, and, in a field of 900–1,000 c.g.s., fills the whole section of the tube. With a field of about 2,100 c.g.s. the luminous portion contracts to a thin stream again, but the deviation is now in the opposite direction to that produced by the weak field. Beyond the pole-pieces the luminosity disappears altogether, the velocity of the particles constituting Goldstein rays appearing to be annihilated in intense magnetic fields.

G. E. A.

350. *Recombinations of Ions in Gases.* **O. W. Richardson.** (Phil. Mag. 10. pp. 242–258, Aug., 1905.)—The hypothesis that recombination only takes place after the kinetic energy of the ions has been reduced by collision with neutral molecules, when the ions are very near each other, affords a satisfactory explanation of the variation of the rate of recombination with the gas-pressure. Practically every ion which makes a collision with four molecules becomes fixed; most of those which make only three, and about one-sixth of those which make only two collisions, recombine. The terms with fewer collisions become more important at low pressures. The quantity obtained by dividing the coefficient of recombination by the sum of the velocities of the two kinds of ions, when expressed as a function of the pressure, is found to depend, in the cases of different gases, on a single parameter, which is the mean free path of an ion in the gas in question at some definite pressure. An ion in CO_2 at high pressures probably contains the same number of gas molecules as an ion in air. A. D

351. *Mobility of the Ions in Saline Vapours.* **G. Moreau.** (Comptes Rendus, 141. pp. 1225–1227, Dec. 26, 1905.)—The mobility is expressed in terms of the ionic charge, the pressure and density of the gas, the diam. of the molecule and the ratio of the latter to that of the ion. The mobility is then measured for several potassium salts [see also Abstract No. 781 (1903)], and the calculated value, reduced by ¼ according to Langevin's correction, is 0·33 the average observed value being 0·39. Using the latter value, the size of the ions is deduced, and is found to vary with temperature. This is explained by saying that the ions behave as if they are composed of an electrified nucleus, of the size of a gaseous molecule, surrounded by 2 to 7 layers of molecules. [See also Abstracts Nos. 165 (1905) and 144 (1906).]

G. E. A.

352. *Radio-active Substances and Electric Discharge.* **G. A. Berti.** (N. Cimento, 10. pp. 39–48, July, 1905.)—Elster and Geitel found that a radioactive substance impedes a discharge between a positive sphere and a negative disc, but noticed no effect when the sphere was negative. Stefanini and Magri confirm this, but find that below certain limiting lengths of spark-gap these effects may be reversed. The author finds that under Elster and Geitel's conditions, with a spark-gap greater than Stefanini and Magri's limiting value, the radio-active substance must, in order to obtain Elster and Geitel's results, be within a certain limiting distance from the spark-gap, beyond which distance the effects are again reversed. This limiting distance itself depends on the radio-active power and upon the length of the spark-gap. The action upon the positive pole predominates when the radiations favour the discharge, and seems to be the only action when they impede it; and it does not appear to be wholly due to the β-rays, since it is not quite extinguished, though it is enfeebled, when these rays are deviated to one side. [See also Willows and Peck, Abstract No. 1036 (1905).] A. D.

353. *Effect of Radiation on the Electric Spark.* **I. Schincaglia.** (N. Cimento, 10. pp. 196–197, Sept., 1905.)—The experiments described in an earlier paper [see Abstract No. 2959 (1904)] are repeated and extended, a large 4-plate Holtz machine, capable of giving a 200-mm. spark, being used; the spinterometer employed is provided with spherical knobs of various curvatures. The previous conclusions are confirmed. No impeding effect could be observed with spherical poles, either equal or unequal, but using a point as negative pole, and a conductor of any shape as positive, the impeding effect could be observed. Concentrating the light from an arc upon the negative pole, the spark passes more easily, and a mechanism is devised for comparing the effect of the light from the arc with the radiation from a second spark. S. G. S.

354. *Ionic Velocities and Spark-length in Liquids.* II. **K. Przibram.** (Phys. Zeitschr. 6. pp. 473–474, Aug. 1, 1905.)—The author has continued his investigations [see Abstract No. 1468 (1905)]. With the worst conducting liquids, such as toluene, benzene, and pentane, the ratio of the ionic velocities depends in high degree on the purity, although the positive brush is always longer than the negative one. With better conducting substances, such as the alcohols, this is not the case, and the ratio of kathode-fall to anode-fall corresponds with the ratio of the length of the positive spark to that of the negative spark. In the tertiary alcohols and the iso-acids, the negative ions appear to move the faster, whilst in the other alcohols and acids the reverse is the case. In accordance with this, the positive sparks are the longer in the former case and the negative ones in the latter. This agreement shows that in these liquids the discharge is determined by the same ions as are the cause of their conductivity; with badly conducting liquids this is not always the case. Some of the results obtained with pure alcohols differ from those previously given by less pure material. T. H. P.

355. *Relation of P.D. and Spark-length.* **G. M. Hobbs.** (Phil. Mag. 10. pp. 617–631, Dec., 1905.)—Using, like Earhart, an interferometer method of measuring the spark-gap, the author shows: (1) A minimum spark-potential is found in all cases where the poles are flat; if not flat, but convex, this minimum condition is complicated by discharge of the material of the electrodes. (2) This discharge of the material of the electrodes exerts an important influence upon spark-potentials at small distances. (3) The carriers of the discharge for small distances come from the metal and not from the gas. Various metal electrodes give various potential gradients. P. E. S.

356. *Conduction of Electricity through Gases between Parallel Plates.* Part II. **A. A. Robb.** (Phil. Mag. 10. pp. 664–676, Dec., 1905.)—In

Part I. [see Abstract No. 1917 (1905)] the equation for the electric field between parallel plates, the space between which is occupied by ionised gas, is shown to be capable of integration when $a = 4\pi e R_1$ or $4\pi e R_2$. Two integrals have to be evaluated, and in the present paper this is performed. For it to be possible to evaluate the integrals in finite form, one ionic velocity must be an exact multiple of the other. In the case of air $R_2 : R_1 = 5 : 4$ very nearly, this ratio being employed. The quantities to be integrated are expanded and integrated term by term, producing convergent series from which tables of the required functions are computed. Tables are given and also a curve indicating the value of the field between two plates. The value of the pressure such that $a = 4\pi e R_1$, that is, about 1¼ atmos., is employed throughout. S. G. S

357. *Point Discharges in Air.* **M. Toepler.** (Ann. d. Physik, 18. 4. pp. 757–774, Dec. 12, 1905. Phys. Inst. d. techn. Hochschule, Dresden, Oct., 1905.)—A series of observations and measurements of the discharge between points in air at a pressure of 10 to 75 cm. of Hg, with special reference to the transition from the point current to the brush arc, and for larger currents than usual, amounting to 0·1 to 1 milliamp., with a spark-gap of 1 to 4 cm. The main result is that in strong point discharges of the glow type the current strength is proportional to the third power of the voltage. Up to about 4 cm. the limiting current strength of the point current is proportional to the width of the gap. The limiting e.m.f. of the point current is the highest e.m.f. which can exist between points in air. The discontinuity in the transition from point current to brush arc is proportional to the square of the gaseous pressure. E. E. F

358. *Phenomena with Large Currents in Vacuum Tubes.* **H. Geiger** (Phys. Zeitschr. 6. pp. 913–914, Dec. 15, 1905. Paper read before the Liége Congrès de Radiologie.)—The experiments of G. Berndt [Abstract No. 535 (1904)] and K. Langenbach [Abstract No. 76 (1904)] on the relation between current, temperature, pressure, and luminosity in the vacuum tube are repeated, using much greater currents than these authors employed. The large current is obtainable by using as kathode a glowing platinum plate covered with CaO, as used by A. Wehnelt [see Abstract No. 2672 (1904)]. Nitrogen and hydrogen are the gases used, the potential gradient in the positive column varying from 2 to 8 volts per cm. Photometric measurements are made with a Glan spectrometer, and it is found that from 0·1 to 1 amp. the luminosity for any given wave-length varies directly as the current. With increasing current the temperature rises; with a tube 3·5 cm. wide, a pressure of 0·48 mm., gradient 7 volts per cm., and a current of 1·5 amps., a temperature of 1,000° is reached. S. G. S.

359. *Polarisation in Vacuum Tubes.* **G. C. Schmidt.** (Ann. d. Physik, 18. 5. pp. 869–903, Dec. 28, 1905. Physikal. Kabinett d. Univ., Königsberg, Oct. 17, 1905.)—The fact that a current between transverse electrodes in a vacuum tube passes more easily when the main discharge is passing than when it is not, may be explained by the increased density or mobility of the ions, but all exact measurements are subject to error on account of the polarisation of the electrodes. The author studies this polarisation by means of a new mercury interrupter, which enables him to break the main discharge and close the transverse current in rapid succession. He finds that even wher

driven at the highest speed the apparatus shows no perceptible polarisation current. If it exists at all, it is less than 10^{-11} amp. after 0·025 sec. The transverse conductivity is the same throughout the tube, and is due to ions gradually liberated from the walls of the tube. It is sensibly independent of the temperature. All these facts prove that the polarisation is not of the same type as electrolytic polarisation in cells, that is to say, it is not due to a chemical alteration within the material of the electrode. Further experiments show that the polarisation is most likely due to a shortage of ions. On exposing a further surface of the electrode, the shortage is halved, and hence also the polarisation. The current density therefore remains the same. The polarisation is least in the glow light, and greatest in the kathode dark space. When the probe is charged negatively, it attracts positive ions, which give up their charges and produce the current. The supply of positive ions may become exhausted, and leave only the negative ions about the negative probe, and these would constitute the polarisation. On changing the current strength of the main discharge, the strength of the transverse current changes in the same proportion, the polarisation remaining the same. As regards the anode- and kathode-falls at the probes, the author finds that both are much greater in the kathode dark space than in other parts of the discharge, owing, no doubt, to its poverty in ions. They increase most rapidly with the current when the probes are immersed in the glow light. The anode-fall is greater than the kathode-fall in the kathode dark space, but in the other parts of the discharge the reverse is the case. E. E. F.

360. *Characteristics of Satisfied Currents in Air according to Observation and according to Riecke's Theory.* **T. Retschinsky.** (Phys. Zeitschr. 6. pp. 472–473, Aug. 1, 1905.)—Riecke [see Abstracts Nos. 128 and 129 (1904)] has given the formula, $R/V^2 = (C - c)[1 - 0{\cdot}2(C - c)/c]/c^2$, as expressing the relation of current to voltage in the case of satisfied currents, where V is the voltage between the electrodes, c the observed current, C the satisfied current, and R a constant which is derived from the ionic constants, and which depends also on the distance apart and cross-section of the electrodes. Observations made by the author in determining the coefficients of recombination of ions afford a means of testing the accuracy of the above formula. It is found that in the region between $c = C$ and $c = C/5$, Riecke's equation corresponds with the observations with a relatively high degree of accuracy.

T. H. P

361. *Experiments with Imperfect Electrical Contact.* **U. Majoli.** (N. Cimento, 10. pp. 152–155, Sept., 1905.)—A platinum wire is laid carefully across two parallel and horizontal similar wires, and a battery and electric bell are placed in series with these; the resistance at the contact is then sufficiently great to prevent the ringing of the bell, but on producing an oscillatory spark discharge in the neighbourhood the resistance falls and the bell rings. This state continues indefinitely unless the wires be shaken. A similar effect may be produced by raising the junctions, one after the other, to a red-heat, the interval that elapses between the heating of the two being immaterial, although the wires may be subjected to shaking. Performing a similar experiment with a broken filament inside an incandescent lamp, a similar result may be obtained with the spark discharge, provided that the external resistance is increased considerably, but on admitting air the phenomenon becomes as well marked as in the case of platinum. The author concludes that the contact resistance is due to a film of gas between the conducting surfaces. In a note added at a later date, the author describes experiments with an oxidisable metal (iron), from which he concludes that the resistance is due to the film of oxide, and falls considerably when the oxide is reduced.

S. G. S.

362. *Measurement of High-frequency Currents and Electric Waves.* **J. A. Fleming.** (Soc. Arts., Journ. 54. pp. 159–168, Dec. 29, 1905; pp. 192–199, Jan. 5; 208–213, Jan. 12; and pp. 223–229, Jan. 19, 1906. Electrician, 56. pp. 520–522, Jan. 12; 556–558, Jan. 19; 638–641, Feb. 2; 670–671, Feb. 9, *et seq.*, 1906.)—A series of four Cantor lectures, in continuation of those dealt with in Abstracts Nos. 1135 (1901) and 1067B (1903), divided into the following sections: Measurement of High Frequency, Capacity, Inductance, and Resistance; Measurement of High-frequency Current and Voltage; Measurement of Frequency and Resonance; Stationary Electric Waves on Wires. The whole forms a compact *résumé* of the present state of our knowledge on the subject, and includes results from some of the most recent researches. A new spark-counting device is described. In this a paper tape is passed between two spark-balls. On an oscillatory spark passing, the paper is pierced by it. The paper is caused to move by being pressed by a jockey pulley against a wheel driven at a high speed by an electric motor. Things are so arranged that a seconds pendulum, when released, breaks an electric circuit, which normally holds off the jockey pulley, for 1 sec., and also closes the induction-coil circuit for the same time-interval. Having obtained the number of sparks per second, the power put into the condenser can be calculated. In Slaby's (and Simons' [?]) method of measuring spark resistance, the author finds that it is better to use a U-tube containing sulphuric acid and having in it movable pistons, in place of the carbon rheostat. In dealing with the length of wave radiated from a wireless telegraph antenna, the author states that from experiments with the cymometer he has found the wave sent off to be nearly $5l$, where $l =$ length of antenna, thus confirming his statement made in the discussion on Duddell and Taylor's paper, and which was criticised by Duddell [see Abstract No. 1181B (1905)]. For an inductively coupled system, if l' is the length of wire in the secondary, in series with the antenna, the length of wave given off is found (experimentally) to be representable by the empirical formula $\lambda = 5(l + Ml')$, where M varies between 2 and 5 in value.

L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

363. *Photo-thermoelectric Effect in Selenium.* **F. Weidert.** (Ann. d. Physik, 18. 4. pp. 811–849, Dec. 12, 1905. Extract from Inaug. Dissertation, Rostock, 1905. Écl. Électr. 46. pp. 181–182, Feb. 3, 1906.)—Among the three modifications of conducting selenium distinguished by Siemens, the second, a coarse-grained variety, produced by heating amorphous selenium to 200° for 2 hours, shows a distinct thermoelectric effect produced under the influence of light. The author prepared the cells by mounting the selenium on biscuit porcelain roughened by a sand-blast. The cell showed a decrease of thermal e.m.f. of some 3 or 4 per cent., with an illumination of several hundred metre-candles, derived from an osmium lamp. The author is of opinion that this effect is due to physical and not to chemical causes [see Abstracts Nos. 362, 363, and 1513 (1904)]. The crystallised variety of selenium probably shows a similar effect, but the measurements are complicated by its high resistance, its inherent e.m.f., and its polarisation.

E. E. F.

364. *Photo-electric Effect of Selenium.* **C. Carpini.** (Accad. Lincei, Atti, 14. pp. 667–673, Dec. 17, 1905.)—The photo-electric effect ($r_{\text{dark}} - r_{\text{daylight}}/r_{\text{dark}}$) of selenium at 0° is little greater than that at the temperature of liquid air; but above 0° to 100° it falls off, as the temperature increases, to about one-third or one-fourth (tables given) of its value at 0°. Curves are also given showing the variations in the photo-electric effect when the exciting illumination rises from a minimum to a maximum and returns to its original minimum value: the return curve does not coincide with the outgoing curve. The photo-electric changes in selenium occur with considerable slowness. A. D.

365. *Absolute Measurement of Capacity.* **E. B. Rosa** and **F. W. Grover.** (Bureau of Standards, Bull. 1. 2. pp. 153–187, Feb., 1905. Zeitschr. Instrumentenk. 26. pp. 35–37, Jan., 1906.)—Maxwell's bridge method was employed, a rotating commutator of special design being used to charge and discharge the condenser. The first portion of the paper is devoted to a consideration of the formula for the capacity, the object being to make the correction factor as small as possible. The usual stroboscopic device for maintaining a constant speed was abandoned; in its stead the observer at the galvanometer telescope controlled the speed of the driving motor by observations of the galvanometer deflection, the number of revolutions of the commutator and the beats of a chronometer being simultaneously recorded on a chronograph. The average variation in speed was about 1 part in 25,000, and the error in the result due to such variations not more than 1 in 50,000. Some measurements, extending over 5 months, of the capacities of condensers of 0·5, 0·2, 0·2, and 0·1 mfd. show deviations from the mean of 5·6, 13·5, 13·5, and 33 parts in 100,000 respectively. At times there was an uncertainty of a degree or more in the temperature of the condensers, and hence the agreement of the results is not so good as it might otherwise have been. In addition, three air condensers were measured; one of these was by Kelvin and James White, and the other two were designed by the authors and built at the Bureau. The results of the measurements are very satisfactory. F. E. S.

366. *Absolute Measurement of Inductance.* **E. B. Rosa** and **F. W. Grover.** (Bureau of Standards, Bull. 1. 2. pp. 125–152, Feb., 1905. St. Louis Internat. Elect. Congress, Trans. 1. pp. 205–231; Discussion, pp. 231–233, 1904.)—The most obvious method of directly determining the inductance of a coil is that originally proposed by Joubert, and consists in first determining the impedance of the coil and then finding the ohmic resistance of the wire and the frequency of the current employed. In a variation of this method, described by Gray, a non-inductive resistance is placed in series with the coil whose inductance is to be measured, and an alternating current passed through both. By means of an electrometer the differences of potential at the terminals of the non-inductive resistance (R_2) and of the inductive coil (resistance R_1 and inductance L) are measured. The inductance is then given by the expression $L = R_1 [(R_2^2 V_1^2 / R_1^2 V_2^2) - 1]^{\frac{1}{2}}/p$, p being 2π times the frequency of the current, which is to be as nearly simple harmonic as possible. The authors slightly modified Gray's method by varying the resistance R_2 until the difference of potential at its terminals was equal to that at the terminals of the inductive coil, as shown by an electrometer; assuming a sine wave-form, L is then equal to $(R_2^2 - R_1^2)^{\frac{1}{2}}/p$. The resistance and frequency have therefore to be accurately determined. The chief objection to the method is that it is necessary to have a perfect sine current or to know the exact form of the current wave in order to calculate the correction due to any harmonics that may be present. The correction factor for the wave-form is equal to $[(I_1^2 + I_3^2 + I_5^2 + \&c.)/(I_1^2 + 9I_3^2 + 25I_5^2 + \ldots)]^{\frac{1}{2}}$ where I_1, I_3, I_5 are the values of the components of the current of which the relative frequencies are 1, 3, 5, &c. The curves were drawn on a Rosa curve-tracer, which is essentially an alternating-current potentiometer arranged with printing cylinder for automatically recording the curve. The results of three sets of measurements made on two inductance standards of nominal value 1 henry show an average deviation of the separate determinations on any one day of 3 to 10 parts in 100,000. Comparisons of the observations on different days is not possible, as the temperature coefficients of the standards are not known. There is evidence, however, that the coefficient of one of the standards is positive, and of the other negative. F. E. S.

367. *Measurement of Inductance.* **E. B. Rosa** and **F. W. Grover.** (Bureau of Standards, Bull. 1. 3. pp. 291–336, Nov., 1905.)—This paper describes a number of measurements of both large and small inductances by Anderson's method, using (1) a battery as a source of current and a d'Arsonval galvanometer, with a rotating commutator to interrupt and reverse simultaneously the current and galvanometer terminals; or (2), what has proved more satisfactory, an alternating-current and a vibration galvanometer, the latter being tuned to the frequency of the current furnished by the generator. The method has been found rapid and convenient in practice, and in accuracy far exceeds most other methods which have been proposed, and it is more convenient than any other method comparable in accuracy which the authors have employed. The chief disadvantage of the vibration galvanometer lies in the fact that its sensibility decreases rapidly when the frequency of the current varies from the natural period of the galvanometer, but in practice it is not difficult to maintain the frequency at the point of maximum sensibility. The sensibility curve for the galvanometer employed is given. The values obtained for several inductance coils of 100 millihenrys and smaller, measuring them singly and in series in groups of 2 or 3, show deviations of the order 0·01 per cent. from the mean. The authors are now constructing a bridge especially adapted to this work, and hope to improve upon the results given in this paper and make sure of the value of the inductance of a standard coil to at least 1 part in 10,000, excluding the uncertainty of the ohm itself. An interesting graphical solution of Anderson's bridge is given, and shows very simply some of the results derived analytically. The possible sources of error are fully discussed. F. E. S.

368. *Use of Serpentine in Standards of Inductance.* **E. B. Rosa** and **F. W. Grover.** (Bureau of Standards, Bull. 1. 3. pp. 337–348, Nov., 1905.)—In 1896 Wien described [Wied. Ann. 58. p. 553, and Phys. Soc. Abstracts, No. 663 (1896)] the construction of a convenient and permanent form of inductance standard, the spool being of serpentine. This form of inductance standard has since been manufactured by several of the German instrument makers, and the Bureau of Standards has purchased a considerable number of them. In attempting measurements of high precision on these coils [see preceding Abstract] discrepancies were found which were difficult to understand until investigation showed the serpentine to be slightly magnetic and its permeability variable, thus making the inductance of a coil a function of the current passing through it. A number of measurements on two coils wound on serpentine show the inductance to steadily increase with the

current, while the inductance of a coil wound on mahogany remains constant within the errors of measurement. The inductance of a mahogany coil was furthermore shown to be increased by the proximity of serpentine, which effect was imitated by placing iron wire or filings in or near the coil. Chemical analysis shows that the serpentine of one of the spools contains 0·6 per cent. of iron, chiefly in the form of magnetite. Inductance coils wound on pure marble would be free from this objection. F. E. S.

369. *Null Wattmeter Methods for Low Power Factor Circuits.* **E. B. Rosa.** (Bureau of Standards, Bull. 1. 3. pp. 383–397, Nov., 1905.)—The resonance and calorimetric methods for measuring the power expended on low power factor circuits—for instance, on condensers or cables on open circuit—are not adapted to general laboratory work. The simple wattmeter also is not suitable, owing to the necessary corrections which have to be made for the power expended on the ampere coil and for the capacity and inductance of the volt circuit. The author devised a large number of null methods of measuring power in 1898, and employed them for measuring low power factors. In some of these methods an auxiliary coil is wound round the ampere coil. The magnetomotive force due to a current A_3 in the auxiliary coil is made exactly equal to that produced by the same current passing through the ampere coil. If A_1 be the current in the ampere coil, A_2 the current in the volt coil, A_3 the current in the auxiliary coil, and θ_1 the deflection due to A_1 and A_2 acting alone, we have $\theta_1 = \lambda A_1 A_2 \cos \alpha$, where λ is a constant of the wattmeter and α is the phase-difference between A_1 and A_2. If θ_2 be the deflection produced by A_2 and A_3, we have $\theta_2 = \lambda A_2 A_3$ when A_2 and A_3 are in phase. If the current A_3 flows in such a direction that θ_2 and θ_1 are of opposite sign, it is obvious that we can have a zero deflection when they flow simultaneously. In this case $A_1 A_2 \cos \alpha = A_2 A_3$, and thus $\cos \alpha = A_3/A_1$. Several different ways of securing the compensating current A_3 are described. When the capacity of the condenser is small, and therefore the main current A_1 is small, it is sometimes better to pass A_1 through the suspended coil (the volt coil) and A_2 through the fixed coil. This gives rise to other arrangements. The condensers experimented on were Stanley paraffined-paper condensers. To show the accuracy of the results arrived at some of the figures obtained on No. 5 condenser (1·70 mfd.) are given below. The frequency was 120 and the applied p.d. varied between 900 and 1,400 volts. (1) Simple deflection method (at 1,400 volts), $\cos \alpha = 0{\cdot}00565$. No correction applied. (2) Getting zero deflection by putting inductance in shunt circuit (at 1,260 volts), $\cos \alpha = 0{\cdot}00558$. (3) Auxiliary condenser shunt in main circuit (at 910 volts), $\cos \alpha = 0{\cdot}00551$; (at 1,260 volts), $\cos \alpha = 0{\cdot}00540$. (4) Shunt on volt circuit (at 1,260 volts), $\cos \alpha = 0{\cdot}00540$. (5) A transformer used for the compensating current (at 1,260 volts), $\cos \alpha = 0{\cdot}00559$. Same experiment repeated next day, $\cos \alpha = 0{\cdot}00561$. The values of $\cos \alpha$ are in substantial agreement. They are somewhat larger than those found by the calorimetric method for the same condensers by the author, but in the experiments described in this paper distorted waves were used. Since the power-factor is higher the higher the frequency, it is higher for the harmonics, and therefore for the distorted wave. The author is continuing his investigations, and hopes to obtain exact data as to how the energy losses vary with the frequency, the temperature, and the wave-form. A. R.

370. *Standards of the Legal Ohm.* **Girousse** and **P. Janet.** (Soc. Int. Élect., Bull. 5. pp. 693–701, Dec., 1905. Écl. Électr. 45. pp. 450–457, Dec. 23,

1905.)—The mercury standards dealt with by Girousse are four in number, and were constructed by Benoit, of the International Bureau of Weights and Measures, soon after the definition of the legal ohm by the International Conference in 1880. Benoit calculated the value of each of the four resistances from the dimensions of the tubes, and afterwards determined electrically their relative values, the latter determination being also made by Nerville. During 1904–5 Berard again compared the four standards, with results in close agreement with those previously obtained as will be seen from the following table :—

Standards.	1905. Ohms × 10^{-6}.	1885. Ohms × 10^{-6}.	Diff. Ohms × 10^{-6}.
1—2..............	23·2	22	+ 1·2
1—3..............	53·9	59	− 5·1
1—4..............	9·9	15	− 5·1
2—3..............	29·6	37	− 7·4
2—4..............	− 14·5	− 7	− 7·5
3—4..............	− 44·0	− 44	0

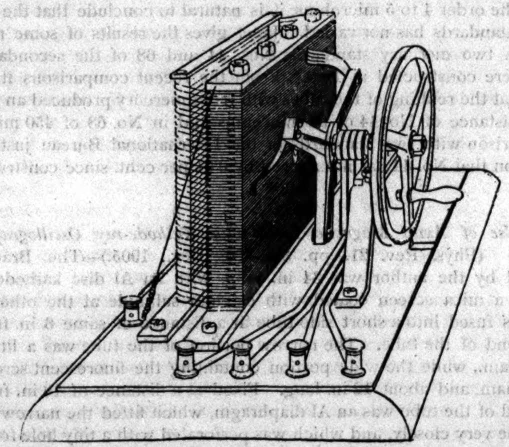
The values given in col. 2 were obtained after the refilling of the tubes with fresh mercury; different values were previously obtained, the differences probably arising from impurities in the mercury. As the experimental errors were of the order 4 to 5 microhms, it is natural to conclude that the mean of the four standards has not varied. Janet gives the results of some measurements on two mercury standards, Nos. 44 and 68 of the secondary type. These were constructed in 1884. From the recent comparisons it is concluded that the refilling of the tubes with fresh mercury produced an increase in the resistance of No. 44 of 90 microhms and in No. 68 of 450 microhms. A comparison with two standards of the International Bureau justifies the assumption that No. 44 has not altered by 0·01 per cent. since construction.

F. E. S.

371. *Use of Axial Magnetic Field with Kathode-ray Oscillograph.* **R. Rankin.** (Phys. Rev. 21. pp. 399–406, Dec., 1905.)—The Braun tube employed by the author was 34 in. long, with an Al disc kathode at one end, and a mica screen coated with calcium sulphide at the other. The anode was fused into a short side-tube at a distance of some 6 in. from the kathode end of the tube. The narrow portion of the tube was a little over 1 in. in diam., while the wide portion containing the fluorescent screen was 6 in. in diam. and about 12 in. long. Fixed at a distance of 18 in. from the screen end of the tube was an Al diaphragm, which fitted the narrow portion of the tube very closely, and which was perforated with a tiny hole for allowing a narrow pencil of kathode rays to pass through. Between the side-tube containing the anode and the diaphragm was placed a coil of 200 turns of No. 10 B. and S. wire, 9 in. in external and 6½ in. in internal diam., and 3 in. in axial length. This coil was slipped over the tube so as to be coaxial with it, and thus produce a magnetic field along the path of the kathode rays. Such a longitudinal magnetic field, when adjusted to a suitable intensity, was found to lower the discharge voltage of the tube, to improve the definition and intensity of the fluorescent spot without causing the unsteadiness which occurs at high voltages, and to furnish a means of varying, within certain limits, the sensitiveness of the oscillograph, as the velocity of the kathode rays was found to be affected by the magnetic field. The difficulty which arises in continuous working on account of the steady improvement in the

vacuum and consequent rise in the voltage may be surmounted by the use of a device due to Ryan, which consists in cementing into the side of the tube a platinum tube about 1 mm. in diam., projecting both inside and outside the glass tube, the outer end being, of course, closed. When the platinum is heated to a dull red heat it evolves a sufficient quantity of gas to restore the vacuum to its original value. The author gives an account of a number of experiments undertaken with the view of ascertaining the nature of the action due to the longitudinal field, and compares the results obtained with those found by Birkeland [Abstract No. 511 (1898)], Almy [Abstract No. 2145 (1901)], and Willows [Abstract No. 1037 (1905)]. [See also Abstract No. 275 (1904).]
A. H.

372. *Caré's Apparatus for producing Sinusoidal Currents.* **Caré.** (Archives d'Él. Médicale, 14. pp. 23–32, Jan. 10, 1906.)—The author describes his "sinusoidor," primarily designed for electro-medical purposes, by which currents of very approximately sine form can be obtained from a source of direct current. As will be seen in the Fig., the apparatus consists of a series of 75 bars insulated from one another and provided with a smooth surface as in a commutator. Each bar is connected to the next by means of a resistance r (here 4 ohms), so that a direct current passing from the top to the bottom bar will suffer an equal p.d. drop at each bar. To obtain three-phase sinusoidal currents, three brushes spaced 120° apart are used, as in the Fig.; for single-phase currents two brushes at 180°. The theory of the apparatus is dealt with and the necessary condition for the wave to be almost sinusoidal pointed out—that the external resistance is much greater than the sum of the resistances between the top and bottom bars. A modification is also described, in which the bars are built up to form a circular commutator. In this case the resistances between the bars must be graduated, for uniform rotation of the brushes, otherwise a zigzag straight-line wave is obtained coinciding with the sine curve only at the points 0, $\pi/2$, π, $3\pi/2$, and 2π.
L. H. W.



ALTERNATING CURRENTS AND MAGNETISM.

373. *Permeability of Steel Spheres.* **R. H. Weber.** (Ann. d. Physik, 18. 2. pp. 395–405, Nov. 7, 1905. Phys. Inst., Heidelberg, Aug., 1905. Écl. Électr. 45. pp. 505–506, Dec. 30, 1905.)—If a uniform field D exists, and the sphere of permeability μ is placed in it, it has inside a field M. The induction $B = \mu M$. If on the sphere near the equator be wound n turns, then when the sphere is in place the throw on a ballistic galvanometer, $s_1 = CB$; when the sphere is removed, we have $s_0 = CD$, C being a constant. Hence $\mu = 2s_1/(3s_0 - s_1)$ with a field of about 1·25 gausses. After suitable corrections it is found that $\mu = 38{\cdot}44$, for hard steel. P. E. S.

374. *Magnetic Storms and Aurora.* **C. Chree.** (Nature, 73. p. 101, Nov. 30, 1905.)—While as a rule during magnetic storms the deflected needle overshoots in returning to its original position and then oscillates about that position, the deflection of Nov. 15, during the auroral display, resembled an isolated bay on a straight coast-line. The easterly movement of the needle commenced at 8.53 p.m., and in 12 min. the declination decreased by 32′, increasing afterwards by 34′ in 20 min. The bay character was also marked on Nov. 12, when there was no auroral display. The other elements were likewise disturbed, the horizontal force by 200γ on Nov. 12, and by 250γ on Nov. 15. H. B.

375. *Magnetic Effects of Lightning on Volcanic Rocks.* **Gaetano Platania** and **Giovanni Platania.** (Comptes Rendus, 141. pp. 974–975, Dec. 4, 1905.)—While according to Folgheraiter zones of pronounced magnetic polarity are produced in volcanic rocks by lightning, no case had so far been known in which tests had been made before and after the flash had actually been observed. During their investigation of the magnetism of rocks from Mount Etna, the authors noticed the following case near Acireale on a wall built of basalt. Lightning fused a telephone wire; the 2·2-mm. earth wire running along the wall and not insulated from it remained intact, and the stone on both sides of it, to a distance of 13 cm., proved strongly magnetic. The next morning, while there had only been a trace of magnetism previously, the polarity indicated that the current had travelled upward. The lightning conductor of a new building was also struck. This conductor, a copper bar of 8 mm. diam., is supported on porcelain insulators at distances of from 9 to 20 cm. from the wall; the wall was afterwards found magnetised in zones from 15 to 25 cm. in width. Here also the lightning appeared to have been directed upward. H. B.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

376. *Electrocution. Experimental Study and Criticism of Modern Official Methods.* **L. C. Robinovitch.** (Archives d'Él. Médicale, 14. pp. 3–9, Jan. 10, 1906. From Journal of Mental Pathology, vol. 7. No. 2.)—Experiments were performed on animals with the currents of Leduc, cardiographic and respiratory curves being recorded. The following conclusions were arrived at: The kathode should be applied on the forehead and the anode on the abdomen. The animal, as far as can be judged, loses consciousness at the moment the current is closed. "Electric sleep" is produced in a rabbit at 5 volts. All sensibility and voluntary motility are abolished. With the

same animal a voltage 2½ times as great causes electrocution. Neither œdema nor vesication are produced at the points of contact with the electrodes, whereas in official electrocutions these accidents always take place. The voltages employed officially are too high, and apparently no importance is attached to the position of the electrodes. Probably the voltage necessary lies between 150 and 200 volts. Tracings are given showing the effects of the current on the heart and respiration of a rabbit. The closure of the current (12 volts giving 2 to 3 milliamps.) produces first a deep inspiratory movement, followed by complete inhibition of respiration with persistence of the heartbeats, which are feeble. In spite, however, of the continuance of the current, the pulsations gradually increase in amplitude. In the experiment recorded the current was applied for successive periods of 10, 27, 23, and 32 sec. with intervening intervals. For the last period the voltage was raised to 14 volts and caused death. An animal thus electrocuted can sometimes be resuscitated by the application of rhythmic excitations with the same current.

H. W. P. Y.

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377. *Kinetic Theory of Electrons and Radiation.* **T. Tommasina.** (Écl. Électr. 45. pp. 81–88, Oct. 21, 1905. Phys. Zeitschr. 7. pp. 56–62, Jan. 15, 1906. Paper read before the Liége Congrès de Radiologie.)—A compact non-mathematical *résumé* of recent hypotheses on these subjects. E. H. B.

378. *Mechanism of Electric Current, Ions and Electrons.* **Langevin.** (Soc. Int. Élect., Bull. 5. pp. 615–639, Nov., 1905.)—A *résumé* of recent researches and the new views which they give of the mechanism of the phenomena of the electric current and the parts played by ions and electrons. E. H. B.

379. *Inertia of Electrons.* **M. Brillouin.** (Comptes Rendus, 141. pp. 942–945, Dec. 4, 1905.)—Treats mathematically the longitudinal and transverse inertia of electrons, a discussion of the inertia of rotation being promised. E. H. B.

380. *Dynamics of Electrons.* **J. D. van der Waals, Jr.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 509–518, Dec. 6, 1905. Proc. 8. pp. 477–485, Dec. 21, 1905.)—A mathematical discussion of the dynamics of electrons at high speeds, radiation, &c., on the theories of Lorentz and Sommerfeld. E. H. B.

381. *Mechanics of Electricity and Heat.* **E. Riecke.** (Phys. Zeitschr. 6. pp. 754–755; Discussion, p. 755, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—Paper and discussion on the value of the kinetic energy of a moving electric particle possessing the unit absolute temperature. Riecke's theory would make this value 3/2, Drude's 4/3, while a more general theory due to Lorentz makes it 8/9. No theory is in accord with experiments, which give a mean value of 1·41. E. H. B.

382. *Dielectric Strain along the Lines of Force.* **L. T. More.** (Phil. Mag. 10. pp. 676–695, Dec., 1905. Paper read in part before the St. Louis Internat. Elect. Congress, 1904; and the Amer. Physical Soc., March, 1905.)—A *résumé* of previous work, theoretical and experimental, on electrostriction, concluding with a description of the author's researches, in which no elongation or contraction could be detected when the plates of the condenser were charged to any potential up to the breaking-point for the dielectric. [See also Abstract No. 1786 (1905).] E. H. B

383. *Pyroelectricity in Central-symmetrical Crystals.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 394–437, 1905.)—Seeks to account for the pyroelectric properties of certain crystals by the symmetry or asymmetry of the whole or its parts. Thus some crystals, themselves central, are supposed to be built up of acentric individuals. E. H. B.

384. *Theory of the Electromagnetic Field.* **F. Emde.** (Zeitschr. Elektrotechn., Wien, 23. pp. 781–788, Dec. 10, 1905. Écl. Électr. 46. pp. 121–131, Jan. 27, 1906.)—A mathematical paper in which the author discusses the relations connecting potential, p.d., e.m.f., electric intensity, &c. A. H.

385. *Cause of the Volta Effect.* **K. Herrmann.** (Deutsch. Phys. Gesell., Verh. 7. 23. pp. 443–446, Dec. 15, 1905.)—An examination of the researches of H. Greinacher on the cause of the Volta effect [see Abstracts Nos. 1641 and 2094 (1905)]. The conclusion is here reached that Greinacher's experiments, in spite of the thin film of phosphorus pentoxide with which the metal was coated when heated, may be regarded as in favour of the electrolytic theory of the Volta effect. E. H. B.

386. *Incandescence of the Air during Lightning-flashes.* **B. Walter.** (Ann. d. Physik, 18. 4. pp. 863–866, Dec. 12, 1905. Phys. Staatslaborat. Hamburg, Nov., 1905.)—The weaker after-flash frequently seen to follow the main lightning discharge along the same path is explained as a residual discharge, and is not considered as a mere after-glow of the air particles [Touchet, Abstract No. 1787 (1905)], nor as a phosphorescent glow [Schmidt, Abstract No. 2236 (1905)]. In some cases the after-flash occurs 0·014 sec. after the main flash. Photographs of the flashes, taken by a camera moved by clockwork, are shown. G. E. A.

387. *Point Discharge.* **P. Ewers.** (Ann. d. Physik, 17. 5. pp. 781–860, Sept. 26, 1905. Écl. Électr. 45. pp. 224–225, Nov. 11, 1905.)—Contains in greater detail the methods and results of a publication already abstracted. [See Abstract No. 1035 (1905).] R. S. W

388. *Recombination of Ions in Air.* **T. Retschinsky.** (Ann. d. Physik, 17. 3. pp. 518–548, July 18, 1905. Extract from Göttingen Dissertation.)—The coefficient of recombination according to Riecke's method in air at 745–754 mm. pressure is 4,200; according to Stark's method of minimal currents it is 4,090 at 760 mm. With electrodes near one another the absorption of ions by the electrodes is not negligible. The coefficient falls with falling pressures, from 760 to 200 mm., at the average rate of 300 per 100 mm. A. D.

389. *Belt Analogy of Electric Circuit.* **B. B. Brackett.** (Elect. World and Engineer, 46. pp. 986–988, Dec. 9, 1905.)—The author regards the usual hydraulic analogy as in many points unsatisfactory, and develops the analogy of a belt connecting a driving and a driven pulley, the belt being completely immersed in a viscous liquid, the resistance offered by which increases in proportion to the speed of the belt. A. H.

390. *Kathodic Pulverisation* **C. Maurain.** (Comptes Rendus, 141. pp. 1223–1225, Dec. 26, 1905.)—The particles appear to be detached from the kathode by the shock of the α-rays and projected in all directions. When the vacuum tube employed was placed in a magnetic field of about 2,200 c.g.s. the aspect of the deposit was perceptibly affected. The particles are therefore charged electrically, but with e/m much smaller than that of the particles constituting the kathode rays. G. E. A.

391. *Null Method of measuring Small Ionisations.* **N. R. Campbell.** (Cambridge Phil. Soc., Proc. 13. p. 132, Oct. 25, 1905.)—The method consists in balancing the current through the ionised gas against that through a constant volume of air, of which the pressure can be varied, ionised by a constant amount of uranium nitrate. E. C. C. B.

392. *Kathode Rays.* **A. Wehnelt.** (Phys. Zeitschr. 6. pp. 609–610, Oct. 1, 1905. Phys. Inst. d. Univ., Erlangen, Sept., 1905.)—Experimental demonstration of the parabolic path of kathode rays in an electrostatic field. Glowing metallic oxides on the kathodes make the course of the kathode rays visible. A. D.

393. *Capillary Electrometer.* **W. T. Porter.** (Science, 22. pp. 602–603, Nov. 10, 1905.)—A very compact and easily managed form of the apparatus is described, the chief advantage of which is that it may be used at any inclination to the horizontal, and can therefore be attached to the stage of the microscope. S. G. S.

394. *Rectifier.* **A. Soulier.** (Ind. Élect. 14. pp. 544–547, Dec. 10, 1905. Electrical World, 47. p. 61, Jan. 6, 1906.)—The rectifier here described is substantially the same as the earlier form of the Koch vibratory-tongue-rectifier [see Abstracts Nos. 336 (1902) and 2853B (1904)], without the choking coil. The paper includes a mathematical investigation of the operation of the apparatus. C. K. F.

395. *Magnetic Properties in Ferromagnetics from* −186° *to* 1,200°. **K. Honda** and **S. Shimizu.** (Phil. Mag. 10. pp. 548–574, Nov., and pp. 642–661, Dec., 1905.)—The former research by these authors [see Abstract No. 203 (1905)] is here continued in two long papers, and rendered more complete, especially as to range of temperature. The ferromagnetics and various nickel-iron alloys (invars), also tungsten steels are treated. Though the work done is long and valuable there seems to be nothing new calling for special mention. P. E. S.

396. *Magnetisation by High-frequency Currents.* **M. Wien.** (Ann. d. Physik, 18. 5. p. 1077, Dec. 28, 1905.)—Referring to Madelung's work [see Abstract No. 2102 (1905)], the author points out that Madelung's results really show the effect of eddy currents on the hysteresis loop and that this effect increases with the frequency. The author's earlier work, on the other hand, dealt with the hysteresis loop after separation of the eddy-current effects. The two researches cannot therefore be compared. L. H. W.

397. *Coexistence of Paramagnetism and Diamagnetism in the Same Crystal.* **G. Meslin.** (Comptes Rendus, 141. pp. 1006–1008, Dec. 11, 1905.)—This was observed in a cubical crystal of pyrrhotine of 2 mm. wide. When placed in a magnetic balance a repulsion of the crystal was noted for directions near the normal to the magnetic plane of the crystal, so that within a certain conical region the crystal behaved as diamagnetic, and outside of this as paramagnetic. G. E. A.

398. *Exact Measurements in Radiology.* **Curchod.** (Archives d'Él. Médicale, 13. pp. 858–866, Nov. 25, 1905. Paper read at the Liége Congrès de Radiologie.)—The author discusses the various methods employed in accurately measuring the penetration and dosage in radiography and radiotherapeutics. H. W. P. Y.

399. *New Lines of Work in Electro-therapeutics.* **H. Lewis Jones.** (Electrician, 56. pp. 274–276, Dec. 1, 1905. Paper read before the Hunterian Soc., Oct. 11, 1905. From the Lancet.)—The author first of all reviews the various applications of electricity in medicine and surgery. He then describes cases of rodent ulcer which he treated by the introduction of ions of zinc according to the method suggested by S. Leduc. Excellent results were obtained by this treatment. H. W. P. Y.

400. *Advantages of Stereoscopic Radiography.* **T. Marie.** (Archives d'Él. Médicale, 13. pp. 935–941, Dec. 25, 1905.)—The author describes a case in which ordinary radiographs taken of several positions of an injured foot led him to the opinion that one of the cuneiform bones had been fractured, but a stereoscopic radiograph taken subsequently showed at once that all the bones were intact and in their normal positions. He insists on the importance of the stereoscopic method in injuries of the foot. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

401. *Distillation of Copper and of Gold and its Alloys.* **H. Moissan.** (Comptes Rendus, 141. pp. 853–857, Nov. 27, 1905.)—Considerable quantities of copper have been distilled at atmospheric pressure by heating small pieces of the metal in a crucible in an electric furnace, the roof of which was perforated by a hole, covered with a thin glass bell-jar, while a copper pipe, through which flowed cold water, traversed the furnace a few cm. above the crucible and arc. The metal condenses on the tube to a depth of 5–7 mm. in the form of copper threads, resembling filamentous silver, the colour varying from red to yellow. It contains 99·76 per cent. Cu with traces of chalk and graphite, and after removal of the chalk by treatment with acetic acid has a density 8·16, which is lower than that of fused copper, and points to the occlusion of a small quantity of gas. Its surface is more susceptible to the action of moist air, but otherwise it behaves chemically like ordinary copper. (Ibid. pp. 977–983, Dec. 11, 1905. Chem. News, 93. p. 22, Jan. 12, 1906.)—Pure gold and its alloys have been distilled in the electric furnace, using the same arrangement. Gold distils less readily than copper, its boiling-point being intermediate between those of copper and chalk. The metal condenses on the cold tube in fine threads and microscopic crystals, having the ordinary properties of gold. In the distillation of alloys of gold with copper and tin these metals pass over before the gold, and with a tin-gold alloy the deposit on the bell-glass consists of purple of Cassius, a reaction which is general, various purples being produced by silica, zirconia, magnesia, lime, and alumina. **W. H. Si.**

402. *Distillation of Amalgams and Purification of Mercury.* **G. A. Hulett** and **H. D. Minchin.** (Phys. Rev. 21. pp. 388–398, Dec., 1905.)—The absence of any detectable quantity of zinc or cadmium in the mercury distilled from amalgams containing these metals, in an aspirator vacuum of 20 mm. pressure, with air bubbling up through the mercury from a fine capillary to prevent bumping, is attributed to their oxidation by the air and subsequent removal by filtration through a pinhole, and this process is suggested as a ready means of freeing mercury from zinc, cadmium, lead, tin, bismuth, and probably copper. Distillation in a Weinhold still of mercury containing only one part of zinc in a thousand, gave a distillate in which zinc was readily detectable electrically, the amount being determined approximately by measuring the e.m.f. developed in the combination Zn amalgam (*a*) | $ZnSO_4$ | Zn amalgam, (*b*) or in Zn amalgam | KCl . HgCl | Hg, in this latter case using a specially devised cell, by which the test was rendered sensitive to one part of zinc in ten billion parts of mercury. This special cell consists of a crystallising dish in which are placed two mounds of paraffin wax, each 5 mm. high and 25 mm. in diam. Platinum contact wires are passed up through holes in the bottom of the dish and extend up 1 mm. through the wax. Mercury is poured over the bottom of the dish and above it the electrolyte, a globule of mercury being placed on one mound, and of the amalgam to be examined on the other. **W. H. Si.**

403. *Cadmium Alloys of Leady Zinc.* **F. Novak.** (Zeitschr. Anorg. Chem. 47. 4. pp. 421–445, Nov. 20, 1905. K. k. graph. Lehr-und Versuchsanstalt, Wien.)—This paper deals with the properties of various alloys of zinc with cadmium and lead, particularly with reference to the use of zinc for zincographs. The conclusions the author has come to are as follows: (1) The increase of cadmium in leady zinc rolled at 120° C. causes a decrease in the rate of dissolution of the alloy in dilute HCl, and an increase in the time of induction. (2) Cadmium in zinc rolled at 120° increases the rate of reaction in dilute HNO_3. (3) By heating re-crystallised sheet zinc to 270° and also its cadmium alloys, they show a greater rate of reaction in dilute HNO_3 than is the case in metal which has been rolled at 120°. (4) Alteration in the percentage of lead (½–2 per cent.) in refined zinc causes no alteration in the rate of reaction in dilute HNO_3. (5) Saturated solid solution of zinc in lead has a much lower rate of dissolution in dilute HNO_3 than a saturated solid solution of lead in zinc. (6) Observations made in paragraphs 1–5 were based upon the theory of local electric currents set up. (7) Small percentages of cadmium (¼ per cent.) in zinc result in a closer-grained crystalline structure after rolling and heating, as compared with zinc without cadmium. (8) Zinc containing ¼ per cent. of cadmium increases in hardness and tensile strength, but its brittleness decreases. A higher percentage of cadmium (above ½ per cent.) renders the zinc brittle, and less strong than the original material, and has therefore a deleterious effect upon the quality of the zinc.

O. J. S.

404. *Nickel-Manganese Steels.* **L. Guillet.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 825–841, Nov. 30, 1905.)—Upon plotting the diagram of nickel steels in the plane zox, and that of manganese steels in the plane zoy [see Abstracts Nos. 1787B (1904) and 1670 (1905)], the diagram of Ni–Mn steels will be the space contained by the co-ordinate planes and intersected by the planes containing the corresponding lines of the two diagrams. Pearlitic steels fall in the origin tetrahedron, γ-iron steels in the space remote from the origin, and martensitic steels between. The investigation of numerous samples supports this diagram, particularly those which fall between the martensitic and γ-iron regions. Microstructure, and results of mechanical tests and of treatments are given.

F. R.

405. *Thallium-Copper and Thallium-Aluminium Alloys.* **F. Doerinckel.** (Zeitschr. Anorg. Chem. 48. 2. pp. 185–190, Jan. 2, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Temperature-concentration diagrams for both series of alloys are given in the paper. The results for the Tl-Cu series show that the two metals are only partially soluble in one another; the solubility of thallium in copper is found to lie between 84 and 86 per cent., while that of copper in thallium is 1·8 per cent. The two metals form neither compounds nor mixed crystals, and with concentrations of less than 40 per cent. Tl, do not separate out into two layers, the sections showing grey globules of thallium included in the copper. The melting-point of pure thallium was found at 311° C., and this is lowered 9° by the addition of copper, so that there is a eutectic point lying very near the pure thallium end of the diagram. In the case of thallium-aluminium, the two metals appear to be mutually quite insoluble, and, owing to a great difference in density, they always separate into two layers, in each of which only slight traces of the other metal can be found.

W. Ros.

406. *Can Calcium be alloyed with Iron?* **C. Quasebart.** (Metallurgie, 3. pp. 28–29, Jan. 8, 1906. Communication from the Eisenhüttenmänn. Inst. d. k. techn. Hochschule, Aachen.)—Describes a series of efforts to produce calcium-iron alloys by introducing calcium into molten iron and steel in various ways, such as stirring the molten iron with a rod of calcium, throwing pieces of calcium into ladles and moulds during casting, and also by heating the two metals in contact *in vacuo*, both in the form of filings and as solid rods fitted tightly into holes bored in a cylinder of the other metal. In all cases negative results were obtained, samples of the iron on analysis showing no trace of calcium, so that the use of this metal for alloying or de-oxidising purposes is not possible. The author points out that in the analysis of samples of iron for calcium special precautions must be observed, since calcium is readily absorbed in small quantities from glass and porcelain. W. Ros.

407. *Iron-Carbon Alloys rich in Carbon.* **F. Wüst.** (Metallurgie, 3. pp. 1–13, Jan. 8, 1906. Communication from the Eisenhüttenmänn. Inst. d. k. techn. Hochschule, Aachen.)—After giving an outline of the Roozeboom diagram for the iron-carbon alloys, the author points out that the indications of the diagram for the alloys high in carbon are not borne out by facts. The paper describes the investigation of 20 iron-carbon alloys prepared from specially pure materials so as to eliminate the effects of impurities; cooling-curves and micro-sections are illustrated. The alloys contained up to 4·8 per cent. of carbon, and on Roozeboom's view some of these should have shown at least a tendency on the part of the graphite to rise to the surface, but even in very slowly cooled samples the graphite is uniformly distributed, from which the inference is drawn that the graphite is not the product of primary crystallisation from a liquid, but a secondary product. Ledebur's explanation that the formation of graphite is due to the presence of other bodies which render the solubility of carbon in solidifying iron less than in fluid iron, is disproved by comparisons of grey and white irons of similar composition for which the carbon solubility gives totally discrepant results. The author next discusses the arrest-points near 1,135° C., and accepts the view of Heyn and Osmond that they represent the formation of cementite. The various constituents of iron-carbon alloys are then described and outstanding difficulties dealt with. The decomposition of cementite into ferrite plus temper-carbon, at temperatures near 1,000° C., and its application in the production of malleable castings are described, while, finally, the discrepancies which arise between analytical determinations of combined carbon and the results to be expected from the micro-structure are discussed. W. Ros.

408. *Segregation.* **K. Friedrich.** (Metallurgie, 3. pp. 13–25, Jan. 8, 1906. Communication from the Metallog. Laborat. d. k. Bergakad., Freiberg.)—Describes the well-known phenomena of the solidification of alloys as represented by the temperature-concentration diagram, particularly from the point of view of the separation or segregation of the constituents from one another. These metallographic data are then applied to the explanation of the processes of metallurgical separation or purification of metals by the segregation processes. In these processes the impure metal (alloy) is placed on a sloping surface and gradually heated; the eutectic, being the most fusible portion, runs off, leaving the crystals of pure metal, which had separated during the previous solidification, together with a small proportion of the mother-liquor. The process is facilitated by the fact that the contact between mother-liquor and crystals in the solid state is not very intimate, so that considerable time is required for the diffusion which would result in saturation of the mother-liquor at any given temperature—the eutectic is thus drained off before it has time to become saturated. The process will be most favourably applied where the proportion of eutectic is small. Further, those systems of alloys will be most readily treated in this way in which the eutectic point lies well to either side of the diagram, *i.e.*, in which the eutectic contains only a small proportion of one of the constituents. The magnitude of the difference between the melting-points of eutectic and alloy to be treated is also an important factor. The author then applies these considerations to a number of actual groups of alloys. W. Ros.

409. *Overheated Steel.* **A. W. Richards** and **J. E. Stead.** (Iron and Steel Inst., Journ. 68. pp. 84–101 ; Discussion and Correspondence, pp. 102–117, 1905. Iron and Steel Mag. 10. pp. 385–404, Nov., 1905.)—The use of the term "overheated" is discussed, and the following definitions adopted : "Overheating is heating at any point below that which produces incipient disintegration, and results in the formation of large crystals." "Burning is heating to or above the point at which such disintegration occurs ; burnt steel is nearly always coarsely crystalline." The effect of overheating at 1,300° C. for two or three hours, of reheating overheated pieces to 880° or 950°, of annealing, and of quenching at 900° followed by reheating to 330°, upon bars of 0·06, 0·48, and 0·44 per cent. carbon steels, was investigated by tensile tests, ordinary bending, alternate bending through 40° over a die, rotary bending through a constant small angle, and Wöhler's cantilever method. Overheating reduced the power of a steel to endure fatigue ; reheating such steel more than restored the original good qualities in the rolled state ; when the carbon was in the sorbitic state (quenched and reheated) the original endurance was more than doubled. The results confirm those in a previous paper [see Abstract No. 2205 (1904)]. Tests and reheating experiments on a railway wagon axle are described. The structure showed that the metal had been overheated ; it failed at a stamp mark after 20 years' service. The paper concludes with a detailed explanation of the difference between the strength and endurance of steel of coarse and of fine structures, founded chiefly on the properties and arrangements of the two constituents, ferrite and pearlite. F. R.

410. *Thermal Transformations of Carbon Steels.* **J. O. Arnold** and **A. McWilliam.** (Iron and Steel Inst., Journ. 68. pp. 27–55 ; Discussion and Correspondence, pp. 56–83, 1905. Engineering, 80. pp. 422–427, Sept. 29, 1905.) —The data given are chiefly the microstructure and cooling curves of three carbon steels containing respectively 0·21, 0·89, and 1·78 per cent. carbon. The cooling curve of the former is referred to in Abstract No. 1796B (1904). Whilst avoiding much direct reference to the current general theory of iron-carbon alloys, the paper is largely a criticism of several points in it, and of terminology. Prominence is given to the electro-chemical relation of constituents. Because the Fe_3C of pearlite is electro-positive to that of cementite in hypereutectoid steel, it is held that there is a physical difference between the two substances ; the former also is "soluble in iron in the α range of temperature" ; the latter is "insoluble in the α range, but dissolves readily in the β range" ; but whether this is due to the Ac_3 change or merely to temperature is doubtful. The authors also find that cementite dissolves in hardenite at about 900° C. "Austenitic hardenite" is defined as hardenite containing from about 4 to 20 per cent. of dissolved cementite ; its average hardness is about equal to that of quartz. With regard to the separation of

amorphous graphite in high-carbon high-silicon steel, the explanation is offered that it is due to segregation of carbide (partly drawn from pearlite, and surrounded therefore by ferrite) which then decomposes, and leaves graphite surrounded by masses of ferrite. F. R.

411. *Nature of Troostite.* **C. Benedicks.** (Iron and Steel Inst., Journ. 68. pp. 352–363; Discussion and Correspondence, pp. 364–370, 1905. Metallurgie, 3. pp. 89–90, Feb. 8, 1906. Abstract.)—The author opposes Boynton's hypothesis that troostite is β-iron [see Abstract No. 2214B (1904)], and recalls Osmond's original definition. His conclusions may be summarised thus: "If a piece of martensite or austenite has already begun to undergo transformation which ultimately results in pearlite, we have troostite; if the martensite has not succeeded in completely resolving itself into pearlite, we have sorbite. Troostite is the first, sorbite the last stage of transformation between martensite and pearlite." He further considers that between troostite and pearlite there is a continuous transition, troostite thus being a pearlite with ultra-microscopically small particles of cementite, and that in all probability troostite is formed by the transformation *in situ* of martensite, which implies that the carbon it contains must be the same as in the martensite from which it originated. The author considers Boynton's assumption that troostite is β-iron to be without experimental or theoretical support, and regards Kurbatoff's theory that it is a solution of elementary carbon in iron as untenable. Troostite is formed from martensite by an appropriate lessening of the intensity of hardening (rapidity of cooling), especially in places which are in contact with ferrite or cementite, and troostite offers in the domain of alloys an interesting analogy to the colloid solutions. W. Ros.

412. *Influence of Nickel and Carbon on Iron.* **G. B. Waterhouse.** (Iron and Steel Inst., Journ. 68. pp. 376–401, 1905. Engineering, 80. pp. 671–674, Nov. 17, 1905.)—Describes an investigation of the properties of a series of steels with constant nickel content (about 3·8 per cent.) and varying carbon content, the other elements unavoidably present being kept as low and as constant as possible. The conclusions arrived at are that (1) nickel decidedly raises the tenacity without materially reducing the ductility, the ratio of elastic limit to breaking stress being only slightly greater in pure nickel-carbon steels than in carbon steels. (2) The influence of annealing is to lower the tenacity without increasing the ductility. (3) The constituents of these steels in the unquenched condition are ferrite, cementite, pearlite, and graphite, but the pearlite shows a great readiness to segregate into ferrite and cementite. (4) The cementite has the composition $Fe(Ni)_3C$. (5) The eutectoid ratio in these steels appears to lie at about 0·70 per cent. carbon, but in the rolled state no free cementite shows until the carbon content reaches about 1 per cent. (6) Nickel lowers the transformation points Ar_3 and Ar_1 about 20° for every 1 per cent. Ni; and (7) the cementite of these steels is very liable to precipitate its carbon as "temper-carbon." W. Ros.

413. *Densities of Solutions of Sodium Carbonate and Hydroxide.* **R. Wegscheider** and **H. Walter.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2b. pp. 275–315, Feb. and March, 1905. From the I. Chem. Laborat. der k.k. Univ., Vienna.)—The authors give the results of determinations of the densities (1) of sodium carbonate and hydroxide solutions, and (2) of mixed solutions of these compounds, at 60° and 80°. Between 0° and 100°, the

densities of pure sodium carbonate or hydroxide solutions, of concentrations up to 8-normal, may be expressed by the formula—

$$d_t = d_w^t + (a + bt + ct^2)X + (a' + b't + c't^2)X^2,$$

where d_w^t is the density of pure water at the same temperature, X the amount of substance present expressed in terms of normality or as percentage content, while a, b, c, a', b', and c' represent constants. The errors are generally less than 0·002. The densities of solutions containing both sodium carbonate and hydroxide can be calculated approximately by the law of mixtures. Corrected formulæ are given which apply to the pure and also to the mixed solutions.

T. H. P.

414. *Boiling-points of Aqueous Solutions.* **S. M. Johnston.** (Roy. Soc. Edinburgh, Proc. 25. pp. 952–966, 1904–1905.)—The author shows that determinations of molecular weights in aqueous solutions by rise of boiling-point are capable of considerable accuracy, the error usually found being due to the inaccurate determination of the boiling-point of the solvent, which in the case of water is too low. This results in too high a rise of boiling-point of the solution. By using Kranhal's results for the degree of ionisation for high temperatures, and determining the elevation of boiling-point of a solution by a modified form of Jones's boiling-point apparatus, the author calculates the "elevation constant" for a large number of concentrations of different inorganic salts. The "elevation constant" is obtained from the formula $C = \frac{m \cdot W \cdot \Delta E}{1 + (n - 1)\alpha\Delta w}$, where m = molecular weight of salt added, W = weight of solvent used, in gm., ΔE = rise of boiling-point caused by adding the weight Δw of salt, α = degree of ionisation, n = number of ions into which the salt can dissociate. The results obtained show a very good agreement, even up to a concentration of 6 per cent. The author claims that the employment of this method gives increased accuracy to boiling-point work on aqueous solutions, whether it is desired to determine the molecular weight or the elevation constant. [See also Abstract No. 2291 (1902).]

F. J. B.

415. *Temperature Coefficients of Conductivity in Aqueous Solutions; Effect of Temperature on Dissociation.* **H. C. Jones** and **A. P. West.** (Amer. Chem. Journ. 34. pp. 357–422, Nov., 1905.)—The authors have investigated the conductivity of aqueous solutions of a considerable number of salts and acids between the temperatures 0° and 35°. The results, which are in general agreement with the work of other investigators, are as follows: With rise of temperature there is an increase of conductivity, but the percentage increase diminishes, so that a maximum point on the conductivity-temperature curve can be foreseen. The temperature coefficients of conductivity, expressed in conductivity units, in the case of salts, increase with rise in temperature, while with acids they decrease with rise in temperature. A. F.

416. *Electrical Conductivity of Dilute Solutions of Sulphuric Acid.* **W. C. D. Whetham.** (Roy. Soc., Proc. Ser. A. 76. pp. 577–583, Dec. 6, 1905.)—The "equivalent" conductivity of solutions of acids and alkalies reaches a maximum at a concentration of about one to two thousandths of a gm.-equivalent per litre, and then falls rapidly as the dilution is pushed further, It has been suggested that the diminution of conductivity is due to interaction between the solute and the impurities which remain in distilled water; the author has tested this suggestion by measuring the conductivity of dilute sulphuric acid and its variation with concentration, in four solvents—viz., good distilled water; the same water with a trace of potassium chloride and of carbon dioxide respectively; the same water freed from carbonic acid and volatile impurities by repeated boiling under diminished pressure. The results show that the equivalent conductivity of a dilute acid is not affected by boiling the water under diminished pressure, though the conductivity of the solvent is thereby much diminished. The equivalent conductivity is also unaffected by the addition of a small quantity of potassium chloride to the water, though the conductivity of the solvent is thereby much increased; but by the addition of a little carbon dioxide the equivalent conductivity of the sulphuric acid is diminished appreciably. It may be concluded that while the presence of carbon dioxide would produce a diminution of equivalent conductivity of the same character as that observed, it does not explain the total effect. D. H. J.

417. *Molecular Refraction of Salts in Aqueous Solution.* **J. Dinkhauser.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1001–1070, July, 1905. From the Phys. Inst. der. Univ., Innsbruck.)—Entirely different results were obtained as Gladstone's or Lorentz's formula for the molecular refraction was employed. In the former case the values obtained appear to be mainly determined by the volume changes accompanying solution; with the exception of the sulphates, an increase of concentration usually gives values tending toward that of the solid salt. In the latter case the variations of refractive index have a predominant influence; the salts group themselves according to the acid radical, the values for the stronger solutions again tending towards those of the solid salts; the smallest differences are observed in the case of the sulphates and the salts which separate with water of crystallisation.

T. M. L.

418. *Heat of Solution of Aluminium Bromide in Ethyl Bromide.* **H. E. Patten.** (Amer. Electrochem. Soc., Trans. 7. pp. 177–184; Discussion, pp. 184–186, 1905.)—The heat of solution of aluminium bromide in ethyl bromide at about 20° is given for various concentrations, and it is shown that the voltage required to decompose a solution of aluminium bromide in ethyl bromide, with liberation of Al and Br, may be roughly calculated by Thomsen's formula, using as thermal data the heat of formation of anhydrous $AlBr_3$ plus its heat of solution in ethyl bromide for dilute solution. The difference between this calculated decomposition voltage and that experimentally determined is 0·13 volt (23·5 per cent.), or, taking the total voltage of Al against Pt in this solution instead of the decomposition voltage, 0·065 volt, *i.e.*, 10·8 per cent. of the total voltage to be calculated from the heat of solution. This discrepancy is explained by the occurrence of a secondary action at the kathode. The heat of solution when plotted as a function of dilution has a form similar to that of the heat-of-solution curve for sulphuric acid in water. The solution of aluminium bromide in ethyl bromide is hence subject to the same energy considerations as obtain in aqueous solution, although its molecular conductivity curve is radically abnormal. At the same time, it is shown by the freezing-point method that the molecular formulæ of aluminium bromide in an 11 per cent. ethyl bromide

solution—at which concentration the molecular conductivity deviates rapidly from the trend of curve required by the electrolytic dissociation theory—is very nearly $AlBr_3$. The heat of solution when expressed as volts is shown to be very nearly evenly divided between the anode and the kathode. T. H. P.

419. *Thomsen's Measurements of the Heats of Dilution of Acids.* **E. Bose.** (Phys. Zeitschr. 6. pp. 548–558, Sept. 1, 1905.)—The author shows that if Thomsen's data for the total heats of dilution of H_2SO_4 and HNO_3 be plotted against percentage of water added, the curves, although in the main hyperbolic in form, nevertheless possess inflection-points in the region between 70 and 100 per cent. of water. The hyperbolic formulæ used by Thomsen do not therefore reproduce his experimental results in the region referred to, although there is again accidental coincidence in the case of H_2SO_4 at infinite dilution. The author on this account recalculates cubical formulæ from Thomsen's data for the cases of the above acids, and also for HCl, HI, HBr, H_3PO_4, formic and acetic acids. These cubical formulæ cover the whole range of dilution in a fairly satisfactory manner, although in the cases of the two organic acids the agreement is not very good. The author also calculates from his formulæ the differential heats of dilution. F. G. D.

420. *Mutual Solubilities of Diethylamine and Water.* **R. T. Lattey.** (Phil. Mag. 10. pp. 397–399, Sept., 1905.)—Diethylamine and water form one of the few cases in which two liquids miscible at low temperatures separate into two layers when heated. On attempting to repeat Guthrie's observations it was found that different values were obtained for the critical temperatures, and that concordant values could not even be obtained in the author's own experiments. This was traced to dissolution of the soft glass of the tubes. When Jena glass tubes were used concordant results were obtained, which showed the critical temperature to be 143·5°, and the critical concentration at 37·4 per cent. of amine, Guthrie's values being 121° and 19 per cent. T. M. L.

421. *Comparative Cryoscopy.* III. *The Esters in Phenol Solution.* **P. W. Robertson.** (Chem. Soc., Journ. 87. pp. 1574–1584, Oct., 1905.)—Of the results arrived at by the author, the most important one is that phenol does not obey van't Hoff's law of solution. The following is a summary of the results: (1) The monobasic esters in phenol solution (*a*) have a high initial molecular depression, (*b*) have a negative "rate" of association, (*c*) associate slightly in dilute solutions, thus exhibiting a minimum molecular depression. (2) The esters with more than one carboxy-alkyl group have a greater initial molecular depression and a higher negative "rate" of association. (3) The association of the methyl esters and the alkyl formates is greater than that of their isomerides and immediate homologues. (4) The esters with high molecular weights have a considerable initial association, which is almost identical for those compounds with the same number of atoms in the hydrocarbon chain. (5) The irregular molecular depressions and the negative "rate" of association are probably due to the fact that phenol has a great tendency to form molecular complexes. (6) These irregularities disappear in the case of thymol, guaiacol, and *o*-nitrophenol, which are not so strongly associated as phenol. The author further points out that it is an advantage to calculate the molecular depression at each successive addition of the solute, otherwise the minimum in the molecular depression curve tends to be obscured. [See also Abstracts Nos. 926 (1904), 631 (1905).] T. S. P.

422. *Distribution of Iodine between Two Solvents.* **Y. Osaka.** (Coll. Sci. and Engin., Mem. Kyoto, 1. pp. 98–102, 1904–1905.)—The author's experiments deal with the distribution of iodine at 25° between aqueous alcohol and carbon disulphide, two solvents which are practically immiscible if the amount of alcohol present is less than 47·9 per cent. For a given mixture the ratio of distribution is independent of the iodine concentration and of the relative amounts of the two phases. The distribution data obtained are compared with the solubilities of iodine in aqueous alcohol and carbon disulphide, and it is found that the ratios are very nearly identical.

T. H. P.

423. *Osmotic Pressure and Freezing-points of Cane-sugar Solutions.* **H. N. Morse** and **J. C. W. Frazer.** (Amer. Chem. Journ. 34. pp. 1–99, July, 1905.)—The authors describe the methods used and results obtained in the accurate measurement of the osmotic pressure of cane-sugar solutions, making use of porous pots, in the walls of which membranes of copper ferrocyanide are electrolytically precipitated. They find that a solution containing 1 gm.-mol. of solute per litre of solution is not the normal unit for osmotic pressure, but that if 1 gm.-mol. of cane-sugar is dissolved in 1,000 gm. of water, the osmotic pressure of the solution at 20° is exactly equal to the pressure which 1 gm.-mol. of hydrogen would exert at the same temperature if it were reduced to 1 litre in volume. The results obtained with concentrations varying from 0·05 to 1 gm.-mol. of cane-sugar per 1,000 gm. of water, show that the osmotic pressure obeys the gaseous laws, the molecular weight being calculated by means of the formula: $M = W(22{\cdot}488 + 0{\cdot}0824t)/P$, where P is the osmotic pressure at temperature t of a weight W of the substance dissolved in 1,000 gm. of water. The values of the molecular weight obtained vary from 327·9 to 347·7, the mean being 341·2. The authors consider that the so-called abnormal freezing-points at the higher concentrations of a substance may be related to the change of volume produced in the solvent by the solute. They therefore give the results of freezing-point and density determinations of a large number of cane-sugar solutions, from which certain relations have been deduced between the osmotic pressure and the depression of the freezing-point. The following substances, when electrolytically deposited, possess osmotic activity: Aluminium and ferric hydroxides; ferric, uranyl, and cupric phosphates; uranyl, stannous, cadmium, zinc, and nickel ferrocyanides; cobalt, nickel, ferrous, copper, zinc, cadmium, and manganese cobalticyanides.

T. H. P.

424. *Aqueous Solutions of Aliphatic Acids.* **K. Drucker.** (Zeitschr. Phys. Chem. 52. pp. 641–704, Aug. 18, 1905.)—Results are given of measurements of the conductivities, surface tensions, specific volumes, and compressibilities of aqueous solutions of fatty acids. With the help of the "apparent" critical magnitudes, the van der Waals' constants a and b can be calculated for the non-normal lower fatty acids—those capable of association—and especially for water from the coefficients of Eötvös and Ramsay and Shields. It is found that, of the two formulæ given by van der Waals for the relation between the surface tension and the critical pressure—*i.e.*, between a and b—the one according to which these magnitudes are proportional gives the most concordant results. From the compressibilities of the mixtures of fatty acids and water, together with the concentrations taking place when the solutions are formed, the corresponding alterations of internal pressure are calculated and compared with one another. The change of internal pressure of trichloroacetic acid solutions is introduced as a correction variable into the dissociation law; the extension of the law in this direction permits of the calculation of degrees of dissociation, and on allowing for these in the uncorrected law of freezing-point depression, agreement with the cryoscopic determinations is obtained for solutions up to half-molar concentration. The details of the author's work must be sought in the original paper. T. H. P.

425. *Solution of Platinum by Sulphuric Acid.* **M. Delépine.** (Comptes Rendus, 141. pp. 1013–1015, Dec. 11, 1905.)—Investigations were made on the solution of platinum by boiling sulphuric acid, both pure and containing varying quantities of potassium sulphate. The results given express the loss experienced by a thin Pt plate of 50 sq. cm. area each side, when exposed to the attack of the acid. When such a plate was boiled with strong acid for an hour the loss varied from 0·008 to 0·012 gm. per 100 sq. cm. Temperature has a very considerable effect upon the amount dissolved. At 350–355°, the boiling-point of a mixture of 50 gm. $H_2SO_4 + 10$ gm. K_2SO_4, the loss was 0·04–0·05 gm., and at 365–370°, the boiling-point of 50 gm. of $H_2SO_4 + 20$ gm. K_2SO_4, the loss reached 0·12–0·13 gm. In each case the acid became yellow. Further experiments showed that the solution of the Pt was not due to the catalytic action of the small quantity of oxides of nitrogen contained in the sulphuric acid. Ammonium sulphate, on the other hand, retarded the solution. By employing spongy platinum made by igniting the chloroplatinate of aniline, quinine, and ammonium, the loss from 1 gm. in an hour was 0·03, 0·033, and 0·033 gm. respectively. The action of sulphuric acid upon platinum is probably in accordance with the equation $4H_2SO_4 + Pt = Pt(SO_4)_2 + 2SO_4 + 4H_2O$, and the presence of the platinic salt can be recognised by the addition of potassium chloride to the previously diluted acid solution. F. J. B.

426. *Equation of State for Monatomic Substances.* **H. Happel.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 282–306, 1905.)—Assuming the correctness of van der Waals' fundamental ideas, the author calculates theoretically the numerical value of the coefficients a_1 and a_2 in the equation of state: $p = (RT/v)[1 + b/v + a_1(b/v)^2 + a_2(b/v)^3 + \ldots] - a/v^2$ for the case of monatomic molecules. Employing a modification of the method used by Boltzmann (Vorlesungen über Gastheorie, Bd. II. pp. 143–151) he finds, in agreement with Boltzmann, van der Waals, Jr., and G. Jäger, that $a_1 = 5/8$, and that the value calculated for a_2 by Boltzmann, namely, 0·2689, lies between the limits calculated by himself. Assuming, therefore, $a_1 = 5/8$, and $a_2 = 0·2689$, and neglecting terms higher than $(b/v)^3$, the values of the specific constants a, b, and R are calculated for argon, krypton, and xenon, from the critical data as determined by Ramsay and Travers and by Olszewski. It is found that the isothermals and other thermal data for the three monatomic gases agree fairly well with the equations of state as so calculated, except at very low temperatures. This leads to the conclusion that there is correspondence of state amongst these monatomic substances. When the above equation of state is tested at very low reduced temperatures, as can be done in the case of mercury at 0° C., there is, however, disagreement, even when a is regarded as a temperature function. F. G. D.

427. *Reaction Velocities at Low Temperatures.* **J. Plotnikow.** (Zeitschr Phys. Chem. 53. pp. 605–632, Nov. 7, 1905. Extract from Inaug. Disserta-

tion, Leipzig, 1905.)—The author points out that no measurements of this kind have been made before, and mentions various reactions which were tried. The interaction of bromine and ethylene, dissolved in petroleum ether, at about —78° C. can be followed calorimetrically as a lecture experiment, and is accompanied by a contraction in volume which can be followed quantitatively. For this purpose he uses an apparatus consisting of four parts —reaction, correction, thermostat, and low-temperature portions. The volume-change is read in a glass capillary at the top of the reaction tube, which is supplied with a magnetic stirrer. A valve worked from outside admits the required quantities of the liquids through a connected vessel. The correction apparatus, of the same form as the reaction vessel, and filled with one liquid, allows the elimination of all errors due to temperature. A large vacuum glass filled with a well-stirred mixture of CO_2 snow and alcohol was found to give sufficiently constant temperatures, about —78° C., with constant barometric heights. To obtain more constant and lower temperatures liquid air was dropped into the above mixture as required, from a specially constructed vacuum glass. When the measurements had been made with any given mixture, this was siphoned out of the apparatus, mixed with KI solution, and titrated. A correction was necessary for the heating effect of the current in the electromagnet; but this could be experimentally determined. From a series of experiments with various proportions of the components it is shown that the reaction is of the second order. A further series of measurements was made to determine the temperature coefficients at —82°, —86·6°, and —98·2° C. A coefficient of the value of 6·2 is found, but the reasons for this are not followed further. H. H. F. H.

428. *Decomposition of Ammonium Nitrite dissolved in Water.* **W. Biltz** and **W. Gahl.** (Zeitschr. Elektrochem. 11. pp. 409–413, June 30, 1905.)—Although the decomposition of ammonium nitrite in aqueous solution proceeds so as to yield constant values in the expression for a monomolecular reaction, it is in reality bimolecular. But since the concentration of one constituent (ammonium nitrite) is very great compared with that of the other (nitrous acid from hydrolysis of the nitrite) it does not appreciably change during the decomposition. While the monomolecular reaction constant remains constant during each separate series of experiments, it falls in different series approximately proportionately to the concentration. The decomposition of potassium percarbonate proceeds similarly to that of ammonium nitrite. It is recommended that such reactions as the above be known as kryptomolecular. [See also Abstracts Nos. 1850 (1904) and 428 and 1169 (1905.)] T. H. P.

429. *Equilibrium of the Electrolytic Dissociation of Partially Neutralised Acids and Bases.* **Y. Osaka.** (Coll. Sci. and Engin., Mem. Kyōto, 1. pp. 103–113, 1904–1905.)—The author shows that if a weak monobasic acid is half neutralised by a strong monoacid base, the concentration of the hydrogen ions is equal to the dissociation constant of the acid, and is independent of the dilution of the solution. If a mixture of two weak monobasic acids in equivalent proportions is half neutralised by a strong monoacid base, the concentration of the hydrogen ions is equal to the square root of the product of the dissociation constants of the two acids. Also, a solution of the acid salt of a dibasic acid AH_2, may be considered as equivalent to a mixture of two acids (AH)H and AH, in equivalent proportions and half neutralised. Analogous relations hold for partially neutralised weak bases. Experiments previously made by the author on the bi-rotation of dextrose under the influence of ethylenediamine monohydrochloride have been repeated, and it is now found that the velocity constant of the process does not vary greatly with the concentration of the salt, as, indeed, should be the case according to the above theoretical considerations. T. H. P.

430. *Dissociation of Nitric Acid.* **P. Bogdan.** (Zeitschr. Elektrochem. 11. pp. 824–826, Nov. 17, 1905.)—From the distribution of a strong electrolyte between water and an organic solvent it is possible to judge of the validity of Ostwald's dilution law, if the electrolyte has the same molecular weight in the second solvent as its undissociated portion has in water. This method was first applied by Rothmund and Drucker [see Abstract No. 1569 (1904)] to the case of picric acid. The author describes similar experiments with nitric acid, water, and ether. Nitric acid is found to have the normal molecular weight in boiling ether. The results show that Ostwald's dilution law holds strictly in the aqueous phase, yet it is possible that deviations occur in the more dilute solutions. T. H. P.

431. *Measurement of the Mobilities of Complex Ions.* **J. W. McBain.** (Zeitschr. Elektrochem. 11. pp. 961–963, Dec. 22, 1905. Extract.)—The author sketches shortly how it is possible to determine the mobilities of ions in a mixture, and of a complex ion which is dissociated to a greater or less extent. The basis of the method is that the amount of an ion transported is equal to its concentration multiplied by its mobility. From the conditions of the experiment and measurement of the transport numbers for the two simple salts, KI and CdI_2, together with the knowledge of the concentration of $Cd^{\cdot\cdot}$ from e.m.f. measurements, the mobility of CdI'_3 can be calculated [see Abstract No. 1134 (1905)]. The author also refers to the bearing of his work on the question of hydration of ions [see Abstract No. 3325 (1904)]. A. F.

432. *Electrical Phenomena in Symmetrical Liquid Chains.* **M. Chanoz.** (Comptes Rendus, 141. pp. 759–761, Nov. 13, and pp. 881–883, Nov. 27, 1905.)—Experiments are described to show that in the author's liquid chains that are symmetrical as regards concentration, an electrical phenomenon, connected with the presence of a fresh surface of contact, appears (1) when impure electrolytes or salts undergoing hydrolysis are opposed to water, (2) when different concentrations of a mixture or of a hydrolysed salt are opposed to one another, (3) when the following are opposed, viz., different acids, acids and bases, salts to bases or acids, salts to salts giving membranous precipitates. [See Abstracts Nos. 1506 and 1964 (1905).] In a liquid chain, $MR \underset{(1)}{|} H_2O \mid MR$, that is symmetrical as regards concentration and preserves a fresh surface of contact at (1) by the flow of MR into H_2O, a pure non-hydrolysed electrolyte does not exhibit any electrical phenomena. When a solution of an electrolyte develops an e.m.f. in the liquid chain we may conclude either that the electrolyte is contaminated with another electrolyte, or that it has undergone hydrolytic dissociation, and from the amount of the e.m.f. developed and its character we may to some extent infer the nature and amount of the impurity or hydrolytic product. D. H. J.

433. *Chemical Composition of the Nickel Oxide Electrode in Jungner-Edison Accumulators.* **J. Zedner.** (Zeitschr. Elektrochem. 11. pp. 809–813, Nov. 17,

1905. Inst. f. physikal. Chemie d. Univ., Göttingen.)—The assumption of Edison and Marsh that the nickel electrode contained a peroxide NiO_2, seems to have been made chiefly because the highest known oxide Ni_2O_3 gave too low a p.d. The author finds that Ni_2O_3 smeared on platinum does indeed not give a potential above 1·1 volts, that of the oxygen electrode. But when he coated a nickel electrode electrolytically with Ni and oxidised the deposit by means of chlorine, the potential rose to 1·79 volts, that of a Jungner electrode from the Kölner Accumulatoren Werke G. Hagen being 1·77 volts. The quantity of oxide was, however, too small for analysis; better yields were obtained by rotating the anode and neutralising the sulphuric acid, formed during the electrolysis of the sulphate, with alkali, drop by drop, lest the acid re-decompose the oxide. The nickel oxide thus obtained is simply Ni_2O_3 with a variable percentage of water. An especially prepared Jungner electrode, not containing any graphite, yielded a constant potential of 1·757 volts; the potential of an Ni_2O_3 electrode rose during the first two hours from 1·752 to 1·764 volts, and diminished then again to 1·755 volts.

H. B.

434. *Action of the Silent Electric Discharge on Chlorine.* **F. Russ.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2b. pp. 195–214, Feb., and March, 1905. From the Chem. Laborat. des k.k. techn. Gewerbemuseums, Vienna.)—The simultaneous action of the silent electric discharge and ultra-violet light on chlorine produces active chlorine, the activity of which is greatly diminished if either the discharge or the light acts alone. The degree of activity depends on the dielectric and on the drying, and the discharged chlorine retains its activity for a long time at ordinary temperatures, but loses it when it is heated or brought into contact with water. T. H. P.

435. *Oxidation of Nitrogen in the High-voltage Flame Arc.* **A. Stevenhagen.** (Ber. Deut. Chem. Gesell. 38. pp. 2171–2177, 1905.)—A porcelain tube containing iron electrodes, and through which air was passed at various different rates, was used. The discharge voltage was about 20,000 volts, and the current 0·07 amp. The yield of oxides of nitrogen was a maximum when the air velocity was 180 litres per hour, falling off rapidly above this value; at 800 litres per hour the arc disappeared and only the ordinary disruptive discharge remained. All the oxides formed could not be condensed even by the use of liquid air. L. H. W.

436. *Balanced Electrodes.* **W. W. Haldane Gee.** (Faraday Soc., Trans. 1. pp. 237–250; Discussion, p. 250, Aug., 1905.)—The author describes several forms of balance voltameters capable of measuring quantities of electricity sufficiently accurately for industrial purposes. In one type a counterpoised kathode hangs from one pan of a balance and is immersed in a solution of a salt of the metal to be deposited, the increase in weight of the kathode being measured after the current has passed; this form gives good results when copper, zinc, silver or mercury is deposited. In other forms the quantity of electricity is measured by a thin brass hydrometer, serving both as a balance and as a kathode, or by a kathode suspended from a spring-balance device. T. H. P

437. *Castner's Mercury Process for extracting Chlorine and Alkali.* **M. Le Blanc.** [Experimental work by C. Cantoni.] (Zeitschr. Elektrochem. 11. pp. 609–612, Sept. 8, 1905. Communicated from the Inst. f. physikal. Chemie und Elektrochemie d. techn. Hochschule, Karlsruhe.)—On testing Castner's mercury process in a laboratory apparatus, the authors find that when a current density of at least 0·1 amp. per sq. cm., and a high concentration of potassium chloride are used, and the mercury is kept slowly moving, a current yield of over 90 per cent. is obtained with temperatures up to 40°. A special form of apparatus is recommended for such laboratory exercises. T. H. P.

438. *Electrolytic Solution of Platinum.* **R. Ruer.** (Zeitschr. Elektrochem. 11. pp. 661–681, Oct. 13, 1905. Communication from the Inst. f. physikal. Chemie d. Univ., Göttingen.)—In the electrolytic solution of Pt in sulphuric acid, the kathodic component of the alternating current may be replaced by a reducing agent, such as sulphurous acid or ferrous sulphate, provided that the strength and duration of the anodic current are made large enough to bring the Pt to a sufficiently high oxidation-potential, and that the current be interrupted for intervals long enough to allow the reducing agent time to diminish the oxidation-potential of the Pt by a sufficient amount. Under analogous conditions the anodic component may be replaced by an oxidising agent, although here the extent to which solution occurs is greatly lessened. The action of the alternating current on Pt in sulphuric acid is hence equivalent to alternate oxidation and reduction. This behaviour of Pt towards an alternating current shows complete analogy with the phenomena of passivity, and the assumption of an insoluble layer of peroxide on the Pt gives a simple explanation of all the author's observations. The thickness of this layer is calculated to be $0{\cdot}09 \times 10^{-6}$ mm. On repeating Brochet and Petit's experiments [see Abstract No. 1973 (1905)] on the solution of a Pt anode by means of a direct current, the author finds that this takes place to an almost negligible extent. [See also Abstract No. 214 (1904).] T. H. P.

439. *Electrolytic Oxidation of Ammonia and its Dependence on the Anode Material.* **E. Müller** and **F. Spitzer.** (Zeitschr. Elektrochem. 11. pp. 917–931, Dec. 15, 1905. From the Elektrochem. Laborat. d. techn. Hochschule, Braunschweig.)—The authors electrolyse mixtures of ammonia and caustic soda in the anode compartment; the kathode lye is always caustic soda of 20 per cent. When the anode consists of platinum, the chief products are nitrogen and sodium nitrate; a little oxygen and sodium nitrite are also observed, and 23 or more per cent. of the current is unaccountably lost; a little alumina dissolved from the porous diaphragm is re-deposited. When anodes of Cu, Ni, Fe are used, the potentials are lower, and less nitrogen but more oxygen and nitrite are produced; there is no inverse proportionality between the nitrite yield and the potential, however; with cobalt anodes alone some nitrate is also obtained, but they are attacked by the electrolyte, anodes of Pt and Ag are likewise attacked. The addition of salts of these metals to the electrolyte at once lowers the potential of the Pt anode, which becomes covered with the oxide of the metal; even copper oxide is deposited under these circumstances. The Pt anodes then behave like those of the metals in question, and this applies also to anodes previously covered with the oxides of those metals; cobalt oxide is quickly destroyed. The authors suggest a catalytic action of the anode material. H. B.

440. *Oxidations and Reductions during Electrolysis of Iron Salt Solutions.* **Z. Karaoglanoff.** (Zeitschr. Elektrochem. 12. pp. 5–16, Jan. 5, 1906. Phys.-chem. Inst., Leipzig, Aug. 11, 1905.)—The author continues his investigations of the part played by diffusion and convection in his iron titration-coulombmeter [see Abstract No. 1977 (1905)]. The experiments are made with solutions of $Fe_2(SO_4)_3$, $FeCl_3$, $FeSO_4$; the presence of $(NH_4)_2SO_4$, forming Mohr's salt with the $FeSO_4$, does not affect the character of the reactions. The e.m.f. is a function of the time and may to a certain degree be deduced from Peters' and Sand's formulæ; Sand's method for the separation of diffusion and convection is recommended. The product $i\sqrt{\delta}$ is a constant, where i is the current intensity and δ the period in seconds during which the concentration at the electrode runs down to 0. The temperature coefficients of the diffusion constant increase more rapidly than the temperature. Increased concentration diminishes the rate of diffusion, not for $FeCl_3$, however. The convection becomes stronger as the solutions become warmer and more concentrated. Electrodes of bright Pt and electrodes coated with silver, gold, or iridium behave in the same way; platinised Pt yields a higher constant $i\sqrt{\delta}$. The velocity of the chemical reaction depends essentially on the rate of diffusion. H. B

441. *Electrolytic Preparation of Spongy Tin.* **D. Tommasi.** (Comptes Rendus, 142. p. 86, Jan. 8, 1906.)—Spongy tin is produced by the electrolysis of a mixture of 50 parts water, 10 parts stannous chloride, and 1 part water, into which dip two tin anodes, the kathode consisting of a rotating copper disc inserted between them. This disc is only partially immersed in the electrolyte, the part which leaves it, on rotation, passing between two brass plates, which, acting as scrubbers, remove the spongy tin as fast as deposited, and at the same time depolarise the surface of the disc. Channels are provided in which the tin collects, and it is then drained and washed, the separated liquid being concentrated to its original density, and returned to the electrolyser. Employing a small apparatus, having a kathode of 30 cm. diam., with a current of 40 amps., e.m.f. 3 volts, and continuing for 1 hour, 76 gm. of tin were deposited, or 86·36 per cent. of the calculated yield.

W. H. Sı.

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442. *Atomic Weights of Carbon and Beryllium.* **C. L. Parsons.** (Zeitschr. Anorg. Chem. 46. 2. pp. 215–216, Aug. 19, 1905.)—From the results of seven analyses of beryllium acetylacetonate and nine analyses of basic beryllium acetate, the author arrives at the mean values 9·113 and 12·007 for the atomic weights of beryllium and carbon respectively. T. H. P.

443. *Atomic Weight of Chlorine by Direct Burning with Hydrogen.* **H. B. Dixon** and **E. C. Edgar.** (Roy. Soc., Phil. Trans. 205. pp. 169–200, Aug. 24, 1905. Roy. Soc., Proc. Ser. A. 76. pp. 250–252, June 28, 1905. Abstract.)—By burning a known amount of hydrogen (about 11 litres), absorbed by palladium in chlorine, the authors obtain, as the mean of a number of experiments, the value 35·195 ± 0·002 for the ratio Cl : H. T. H. P.

444. *Hardness of Glass.* **A. Lecrenier.** (Soc. Chim. de Belgique, Bull. 19. pp. 16–28, Jan., 1905.)—Describes a method of measuring the hardness of various glasses by noting the time required to grind away the same volume of glass from pieces of similar shape held against a grinding-wheel of sandstone. Conclusions as to the effects of various constituents on the hardness are given.

W. Ros.

445. *Atomic Weight of Iodine.* **G. P. Baxter.** (Amer. Acad., Proc. 41. 4. pp. 73–85, June, 1905. Amer. Chem. Soc., Journ. 27. pp. 876–887, July, 1905. Contribution from the Chem. Lab. of Harvard College.)—The atomic weight of iodine is found to be 126·985 (Ag = 107·930). [See Abstract No. 219 (1905).] T. H. P.

446. *Work of the Alloys Research Committee.* **W. H. Merrett.** (Inst. Mech. Engin., Proc. 4. pp. 1319–1352, July–Dec., 1904. Lecture at Meeting of Graduates, Feb. 8, 1904.)—A paper giving the main features of the researches embodied in the six Reports of the Committee (1891–1904). Some of the figures and photomicrographs are reproduced, and metallographic methods outlined. F. R.

447. *Silicon and Aluminium, and Silicoaluminides.* **E. Vigouroux.** (Comptes Rendus, 141. pp. 951–953, Dec. 4, 1905.)—Pure Si and Al do not unite, but the author has made double silicides of Al and a second metal (Fe, Ni, Cr, Mn, Co, Mo, W, V, &c.). These "silicoaluminides" are frequently definitely crystalline, and resist alkalies, and acids except hydrofluoric. To the formation of compounds of this type he attributes failure to produce pure samples of the above metals in crucibles of clayey matter. F. R.

448. *Clay for Semi-permeable Diaphragms.* **P. Rohland.** (Zeitschr. Elektrochem. 11. pp. 455–456, July 14, 1905.)—The property of semi-permeability is not exhibited by all clays, but is possessed by rich, plastic clays after air-drying. On ignition these clays undergo considerable loss in weight, owing to the water and residual organic matter present. Dissolved crystalloids pass through diaphragms of such clay, but colloids are unable to do so. Towards sodium carbonate, however, the clay is impermeable, the anion of the salt being held back whilst the basic part displaces the lime of the clay. T. H. P.

449. *Liquid Mixtures of Minimum Boiling-point.* **C. D. Holley** and **J. T. Weaver.** (Amer. Chem. Soc., Journ. 27. pp. 1049–1057, Sept., 1905.)—Of 25 pairs of liquids examined 10 give mixtures having minimum boiling-points, 3 show no relative elevation or depression of the boiling-point, and the remaining 12 present no unusual phenomena. The chemical constitution exercises a greater influence on the formation of such mixtures than the close proximity of the boiling-points of the constituents. One constituent remaining the same, mixtures with substances of similar chemical constitution yield similar boiling-point curves. T. H. P.

450. *Viscosity of Liquid Mixtures at their Boiling-points.* **A. Findlay.** (Chem. News, 92. p. 206, Nov. 3, 1905. Abstract of paper read before the British Association, S. Africa meeting, 1905.)—The viscosities were measured of four series of binary liquid mixtures at the boiling temperature of the mixture. It was expected that simpler relationships would be observed than when measurements were made at one temperature, but up to the present this expectation has only been partially realised. T. M. L.

451. *Solubility of Calcium Hydroxide in Mixtures of Glycerol and Water.* III. **W. Herz** and **M. Knoch.** (Zeitschr. Anorg. Chem. 46. 2. pp. 193–196, Aug. 19, 1905. Chem. Inst. d. Univ., Breslau, June 22, 1905.)—The numbers obtained by the authors give variable values for Bodländer's constant, but the expression $W(S + A)/(S + A + W)$ is approximately constant, S being the amount of substance in 100 c.cm. of the solution, A the corresponding amount of acetone or glycerol, and W the amount of water. The numbers given by the above formula for solutions of potassium chloride, sodium chloride, ammonium chloride, succinic acid and boric acid are about the same, as also are those for iodine and calcium hydroxide. Similar relations are found for aqueous acetone solutions. [See also Abstract No. 1986 (1905).] T. H. P

452. *Nature of Crystalline Liquids and of Liquid Crystals.* **R. Schenck.** (Zeitschr. Elektrochem. 11. pp. 951–955; Discussion, p. 955, Dec. 15, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell., Karlsruhe, June 1–4, 1905.)—The author gives a summary of the properties of crystalline liquids and liquid crystals, and of the arguments in favour of the homogeneity of crystalline liquids. In the *discussion,* **Tammann** maintained his position that crystalline liquids are not anisotropic, and that there is no such thing as a liquid crystal. A. F.

453. *Heats of Solution and Dilution.* **R. Wegscheider.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2b. pp. 215–230, Feb., and March, 1905. From the 1 Chem. Laborat. der k.k. Univ., Wien.)—The author develops formulæ for the relations between the different heats of solution and dilution which enable them to be calculated from the total heats of solution expressed as functions of the amount of water present. The method of carrying out the calculation and the accuracy thereby obtainable are illustrated by several examples. F. G. D.

454. *Transformation of a Lateral into a Principal Plait, and* vice versâ. **J. D. van der Waals.** (Archives Néerlandaises, 10. pp. 284–290, 1905.)—The paper, which is accompanied by several geometrical diagrams, deals with a point in the graphical thermodynamics of binary mixtures. F. G. D.

455. *Gibbs's Phase-rule.* **S. Sano.** (Physico-Mathematical Soc., Tokyo, Proc. 2. 25. pp. 391–394, 1905.)—Extension to the case when some of the components are electrified, *e.g.*, ions. R. E. B.

456. *Exact Numerical Values for the Properties of the Plait-point Line on the Side of the Components.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 249–258, Oct. 12, 1905. Proc. 8. pp. 289–298, Oct. 25, 1905.)—It appears that the exact determination of $b = f(x, v)$ is not necessary, but that the two quantities $T/p\,dp/dt$ and dT/Tdx determined for the critical state of a simple substance are sufficient. The equation of state cannot be entirely dispensed with. H. H. F. H.

457. *Properties of the Plait-point Line on the Side of the Components.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 230–240 Oct. 12, 1905. Proc. 8. pp. 271–280, Oct. 25, 1905.)—The principal properties were discussed by the author over ten years ago (Versl., May and June, 1895). The approximate values obtained are compared with Keesom's observations on mixtures of CO_2 and oxygen [Abstract No. 581 (1904)]. The calculations are made on the supposition that *b* is constant, which is known not to be the case, so that there is only approximate agreement. [See next Abstract.] H. H. F. H.

458. *Properties of Sections of Saturation Surface of Binary Mixture on the Side of the Components.* **J. D. van der Waals.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 240–249, Oct. 12, 1905. Proc. 8. pp. 280–289, Oct. 25, 1905.)—A general discussion which cannot readily be abstracted. [See Abstract No. 1992 (1905).] H. H. F. H.

459. *Well-known Formulæ derived from a General Equation of State.* **G. van Iterson, Jr.** (Zeitschr. Phys. Chem. 53. pp. 633–640, Nov. 7, 1905.)—The author employs the equation of state for "corresponding" substances $F(p, v, T, a, b, c) = 0$, and combines it with the Maxwell criterium, the Clausius-Clapeyron formula, and the Mathias straight-line law, obtaining well-known equations found empirically or derived by van der Waals from his equation. H. H. F. H.

460. *Free Energy.* **K. v. Wesendonck.** (Phys. Zeitschr. 6. pp. 545–548, Sept. 1, 1905.)—Richards has expressed the view that the measurement of chemical affinity by means of the change of free energy rests on an assumption. The author gives a short sketch of the free-energy theory, and attempts to show that the total variation of the free energy can be expressed as a sum of partial variations, corresponding to the work performed by various classes of "forces," and that a certain number of these partial variations correspond to the work of the forces of chemical affinity, and so can be properly regarded as a measure of chemical affinity (?). F. G. D.

461. *Velocity of Decomposition of Nitrous Oxide.* **M. A. Hunter.** (Zeitschr. Phys. Chem. 53. pp. 441–448, Oct. 20, 1905.)—Nitrous oxide decomposes at 700°–900° into nitrogen and oxygen, and the reaction is bimolecular. The influence of temperature on the equilibrium is represented by $\log_e k = -31800/T + 24{\cdot}12$. Moisture has no appreciable influence on the reaction. The oxidation potential of nitrous oxide is about 0·39 volt above that of oxygen. A. F.

462. *Diffusion Potential between two Dilute Aqueous Solutions.* **N. Bjerrum.** (Zeitschr. Phys. Chem. 53. pp. 428–440, Oct. 20, 1905. Phys.-chem. Inst., Leipzig, July, 1905.)—The author finds that when a concentrated solution of potassium chloride is interposed between two solutions the electrode potentials assume more constant values. A. F.

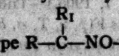
463. *Molybdates.* **A. Junius.** (Zeitschr. Anorg. Chem. 46. 4. pp. 428–448, Sept. 18, 1905. Extract from Dissertation, Berlin.)—Electrolysis of solutions of sodium, potassium, and ammonium molybdates, using a diaphragm, gives, firstly, certain complex molybdates, and finally, free molybdic acid. T. H. P.

464. *Address to Chemical Section of the British Association*, 1905. **G. T. Beilby.** (Chem. News, 92. pp. 85–91, Aug. 25, 1905.)—Deals with metal films (molecules in the solid state); molecules in solution; mechanical view of dissociation in dilute solutions.

465. *Diamonds.* **W. Crookes.** (Chem. News, 92. pp. 135–140, Sept. 22; 147–150, Sept. 29, and pp. 159–163, Oct. 6, 1905. Nature, 72. pp. 593–599, Oct. 12, 1905. Abstract. Lecture delivered before the British Assoc. at Kimberley, Sept. 5, 1905.) [See also Abstract No. 2296 (1905).]

466. *Use of Rotating Anode and Mercury Kathode in Electro-analysis.* **L. G. Kollock** and **E. F. Smith.** (Amer. Chem. Soc., Journ. 27. pp. 1255–1269, Oct., and pp. 1527–1549, Dec., 1905. Contributions from the John Harrison Lab. of Chemistry, Nos. 95. and 99.)—Details are given for the quantitative deposition from solution of zinc, copper, nickel, cobalt, chromium and iron. T. H. P.

467. *Pyrogenic Reactions and Syntheses by means of the Electric Current.* IV. **M. Joist** and **W. Löb.** (Zeitschr. Elektrochem. 11. pp. 938–944, Dec. 15, 1905. Extract from Inaug. Dissertation of M. Joist, Bonn, 1905.)—Behaviour of perchlorethylene, acetylchloride, trichloracetic acid and bromoform. A. F

468. *Electrosyntheses in the Group of the Oximido-esters.* **G. Ulpiani** and **G. A. Rodano.** (Accad. Lincei, Atti, 14. pp. 601–607, Dec. 3, 1905.)—Using a Becker electrolytic cell and employing currents of about ½ amp. the authors have electrolysed dilute solutions of the following salts: the sodium salt of oximidomalonic ethyl ester, the potassium salt of α-oximido-propionic ethyl ester and of α-oximido-butyric ethyl ester. From the results they conclude that compounds of the type  $R\text{—}\overset{\overset{R_1}{|}}{C}\text{—}NO\text{—}Me$ split up, under the influence of the electric current, into a metal which liberates hydrogen at the negative pole and into an anion, $\overset{\|}{C}=NO-$, which goes to the positive pole. At the positive pole the anions unite in pairs and give rise to compounds which no longer contain oximido-hydrogen. D. H. J.